

MANAGING SOFT TISSUES

GINGIVAL PHENOTYPE

previously referred to as the gingival biotype

evaluated with probe placed in sulcus (the 1mm threshold).
Thin where probe can be seen through tissue vs. thick when
probe cannot be seen through tissue (kan et al 2003)

probe not visible at $>0.8\text{mm}$ gingival tissue but no defined
thickness threshold to reliably classify thin vs. thick (frost et
al 2015).



ELATUS

BRIGHT IDEAS,
MATERIALS &
INNOVATIONS

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mucogingival deformities

recession & lack of keratinized tissue



background

classification
systems - why?

monitor vs
treatment

graft types

surgical technique

digital monitoring

conclusions



mucogingival deformities

lack of keratinized tissue & recession

Cortellini P, Bissada NF. Mucogingival conditions in the natural dentition: Narrative review, case definitions, and diagnostic considerations. 2017 World Workshop. J Periodontol 2018;89 (suppl 1): S204-213.

recession

- apical shift of the CEJ resulting in root exposure
- frequent in adults . ↑ with age
- occurs with good or poor oral hygiene
- impact: esthetics . dentin hypersensitivity . carious/NCCLs

keratinized tissue (kt) width & thickness

- favorable oral conditions . a minimum amount is not needed
- lack of or minimal kt increases recession/inflammation risk

periodontal biotype/phenotype includes ...

- keratinized tissue thickness
- keratinized tissue width
- bone morphotype (thickness)
- tooth dimension

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periodontal/gingival
phenotype

Kim DM, Bassir SH, Nguyen TT. Effect of gingival phenotype on the maintenance of periodontal health: An American Academy of Periodontology best evidence review. J Periodontol. 2020;91:311-338.

gingival thickness & keratinized tissue width

bone morphotype [thickness]

visual inspection [basically guessing]

probe transparency [good reproducibility] De Rouck T et al. J Clin Periodontol 2009; 36:428-433.



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bone morphotype [thickness]

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phenotype includes

1 mucogingival junction [mgj]

2 keratinized tissue width [ktw]

3 root exposure [recession depth]

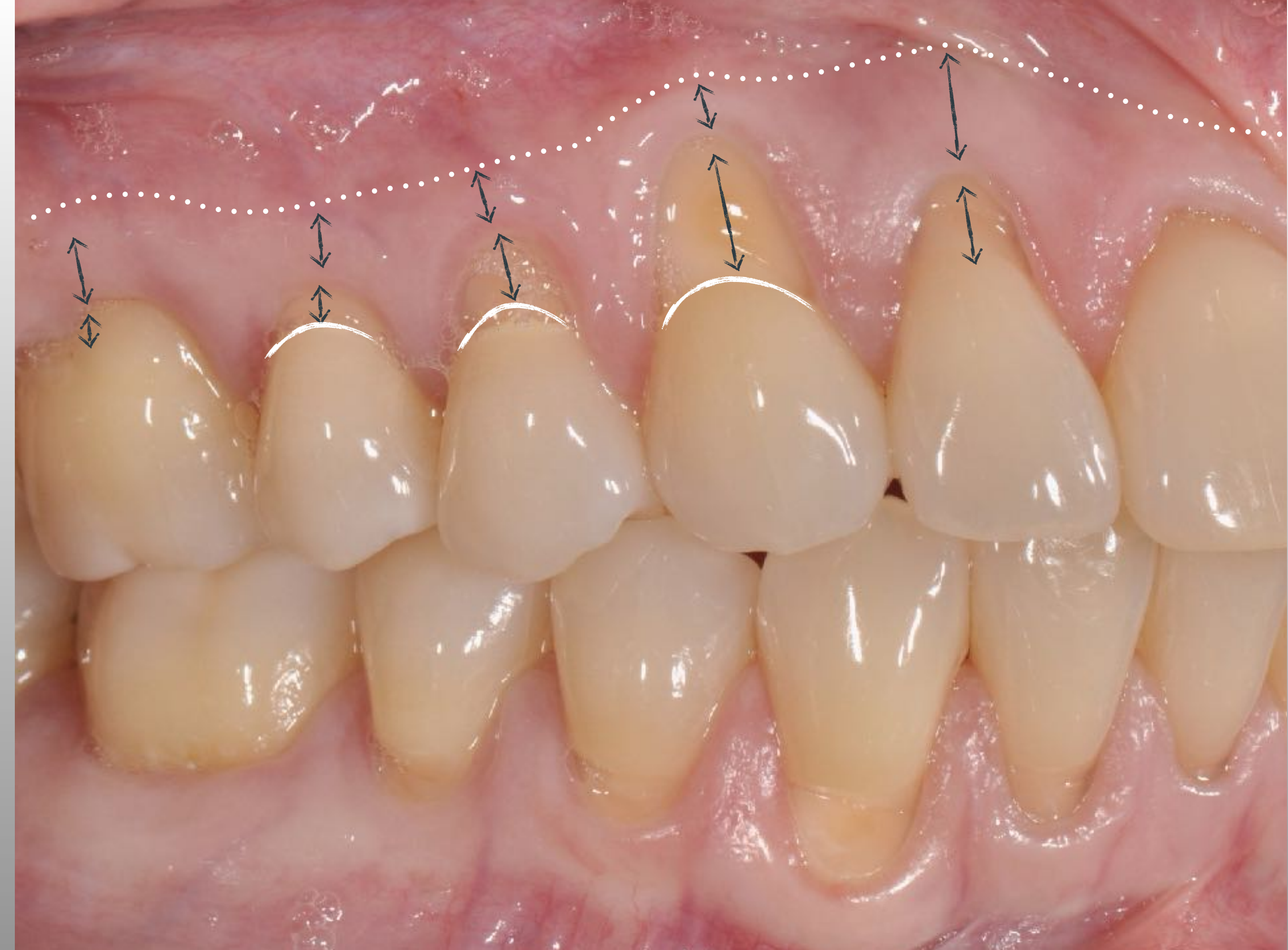
4 tooth conditions that affect CEJ identification

(caries/restorations/NCCL surface discrepancies at CEJ.)

Pini-Prato G. J Periodontol 2010;81:885-890.

5 interproximal embrasure fill [bone/soft tissue]

6 gingival/bone thickness



keratinized tissue width



historic/landmark recommendations

- Lang/Loe 1972 - 2mm KG/1mm AG required for health
- Miyasoto et al 1997 - minimal KT (<1mm) not more prone to inflammation & recession with proper care

today?

- KTW might be important but amount is still unclear
- consider patient age & what has to be done in this region
- is the tissue free of inflammation
- is it stable

soft tissue thickness



thin tissue. probe can be seen through tissue ($\leq 1\text{mm}$)
thick tissue . probe cannot be seen through tissue ($>1\text{mm}$)

kan jy et al 2003
de rouck t et al 2009

(Cortellini 2018- thick 38.4%/thin 30.3%/normal 45.7%)

predominantly ♀

thin phenotype in $< 1/3$ rd of patients

less vascular . \uparrow risk for change

\uparrow response to plaque

(Lee et al. 2013, 2018)

racial variations [Asians - thinner phenotypes]

bone thickness [the morphotype]



- natural ridge architecture/bone volume
- root dimensions
- malpositions
- dominant roots

this is primarily a bone problem [& secondary gum problem]



bone thickness [referred to as the morphotype]

- natural ridge architecture/bone volume
- root dimensions
- malpositions
- dominant roots

4 months healing
CT graft 'masks' the underlying problem



why do we treat recession?

- stop progressive recession
- improve esthetics
- address dentin hypersensitivity
- pre-prosthetic & pre-ortho tissue enhancement
- facilitate oral hygiene & reduce biofilm accumulation
- improve tissue health- eliminate isolated facial pockets and frenum pulls
- cover roots & reduce root caries risk

mucogingival deformities

what if existing recession is left untreated?

- untreated buccal recession defects . good oral hygiene . likely to progress (78% of defects)
- pre-existing keratinized tissue amount influences the development and progression of recession.
- sites lacking keratinized tissue appear more susceptible to further clinical attachment loss

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JOURNAL OF Periodontology
Clinical Science
Long-Term Outcomes of Untreated Buccal Gingival Recessions: A Systematic Review and Meta-Analysis
Leandro Chambrone, Dimitris N. Tatakis
First published: 01 July 2016 https://doi.org/10.1902/jop.2016.150625 Cited by: 23
Read the full text > PDF TOOLS SHARE
Abstract
Background: This review aims to: 1) assess the long-term outcomes of untreated buccal gingival recession (GR) defects and the associated reported esthetic and functional alterations; and 2) evaluate which factors influence the progression/worsening of dental and periodontal tissue conditions of untreated GR defects.
Methods: Interventional and observational studies with duration of >24 months reporting outcomes from adult patients with localized or multiple GR defects not treated by root coverage or gingival augmentation procedures were considered eligible for inclusion. MEDLINE and EMBASE databases were searched for articles published through July 2015. Random-effects meta-analyses were performed comparing baseline versus most recent follow-up outcomes (i.e., number of patients with >1 GR and number of sites with GR).
Results: Of 378 potentially eligible articles, eight (reporting six studies) met inclusion criteria. Of 1,647 GR defects with baseline and follow-up information, 78.1% experienced GR depth increase during the follow-up period, whereas the remaining experienced decrease or no change. Moreover, there was a 79.3% increase in the number of GR defects among the patients followed (i.e., new GR defects). Pooled estimates (data from four studies) showed significantly increased odds of recession development long term, regarding either number of patients (odds ratio 2.43; $P = 0.03$) or number of sites with GR (odds ratio 2.16; $P = 0.0005$).
Conclusion: Untreated recession defects in individuals with good oral hygiene have a high probability of progressing during long-term follow-up.

mucogingival deformities

what if existing recession is left untreated?

- lack of attached gingiva/motivated/good oral hygiene
- FGG treated vs untreated sites followed for mean 23.6 years
 - ↓ recession in 83% of 64 treated sites
 - ↑ recession in 48% of 64 untreated sites
- recession increase over 20 years
 - 1mm in 24 sites
 - 2mm in 6 sites
 - 3mm in 1 site
 - does not lead to tooth loss

JOURNAL OF Periodontology

Clinical Science

Periodontal Conditions of Sites Treated With Gingival Augmentation Surgery Compared With Untreated Contralateral Homologous Sites: An 18- to 35-Year Long-Term Study

Giancarlo Agudio, Pierpaolo Cortellini, Jacopo Buti, Giovanpaolo Pini Prato

First published: 01 December 2016 | <https://doi.org/10.1902/jop.2016.160284> | Citations: 22

[Read the full text >](#) PDF TOOLS SHARE

Abstract

Background: The aim of this split-mouth study is to compare long-term (18 to 35 years) periodontal conditions of sites treated with gingival augmentation procedures (GAPs) and untreated homologous contralateral sites.

Methods: Forty-seven patients with 64 sites (test group), with lack of attached gingiva associated with recessions, were treated with marginal or submarginal free gingival grafts. Sixty-four contralateral homologous sites (control group), with or without gingival recession (GR) and with attached gingiva, were left untreated. Patients were recalled every 4 to 6 months during follow-up period. GR depth, keratinized tissue (KT) width, and probing depth were measured at baseline (T₀), 1 year after surgery (T₁), during follow-up (10 to 27 years, T₂), and at the end of the follow-up period (18 to 35 years, T₃). Multilevel and regression analyses were conducted.

Results: At the end of T₃, 83% of the 64 treated sites showed recession reduction (RecRed), whereas 48% of the 64 untreated sites experienced increase in recession. Treated sites ended with gingival margin (GM) 1.7 mm ($P = 0.01$) more coronal and KT 3.3 mm ($P < 0.001$) wider than untreated sites. In grafted sites, KT at T₃ remained stable compared with T₁ value (4.1 mm, $P < 0.001$).

Conclusions: Sites treated with GAPs resulted in coronal displacement of GM with RecRed up to complete root coverage, whereas contralateral untreated sites showed a tendency to increase in existing recession or develop new recession during the 18- to 35-year follow-up.

background

classification systems - why?

monitor vs treatment

graft types

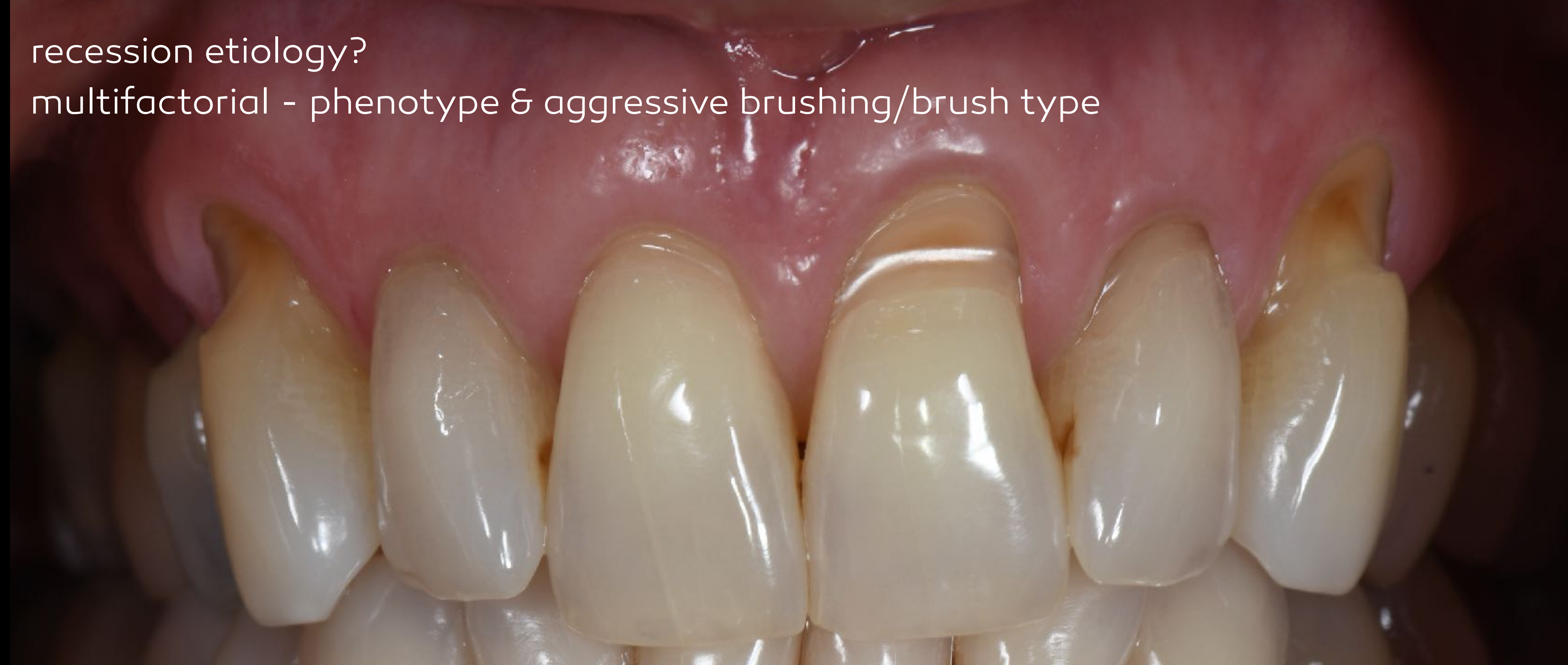
surgical technique

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recession etiology?

multifactorial - phenotype & aggressive brushing/brush type








recession etiology?

recession risk factors AAP 2018

apical shift of gingival margin with respect to the CEJ

-  evidence
-  possible
-  limited support

1 thin gingival phenotype

2 lack of attached tissue (consensus minimum: 2mm keratinized tissue/1mm attached gingiva)

3 root position & bone thickness

4 toothbrushing method [impact of abrasive toothpastes/technique]

(inconclusive association)

5 toothbrushing duration . force . frequency of changing brush . bristle hardness

(potential association)

6 intrasulcular margins & minimal/no attached gingiva . iatrogenic restoration designs

(low evidence)

7 orthodontics . facial direction of movement & gingival thickness <2mm

(low evidence/ site dependent)

8 chronic inflammation & shallow vestibular depth, frenum position, clefts

(low evidence)



no ortho



prior ortho



no ortho



prior ortho



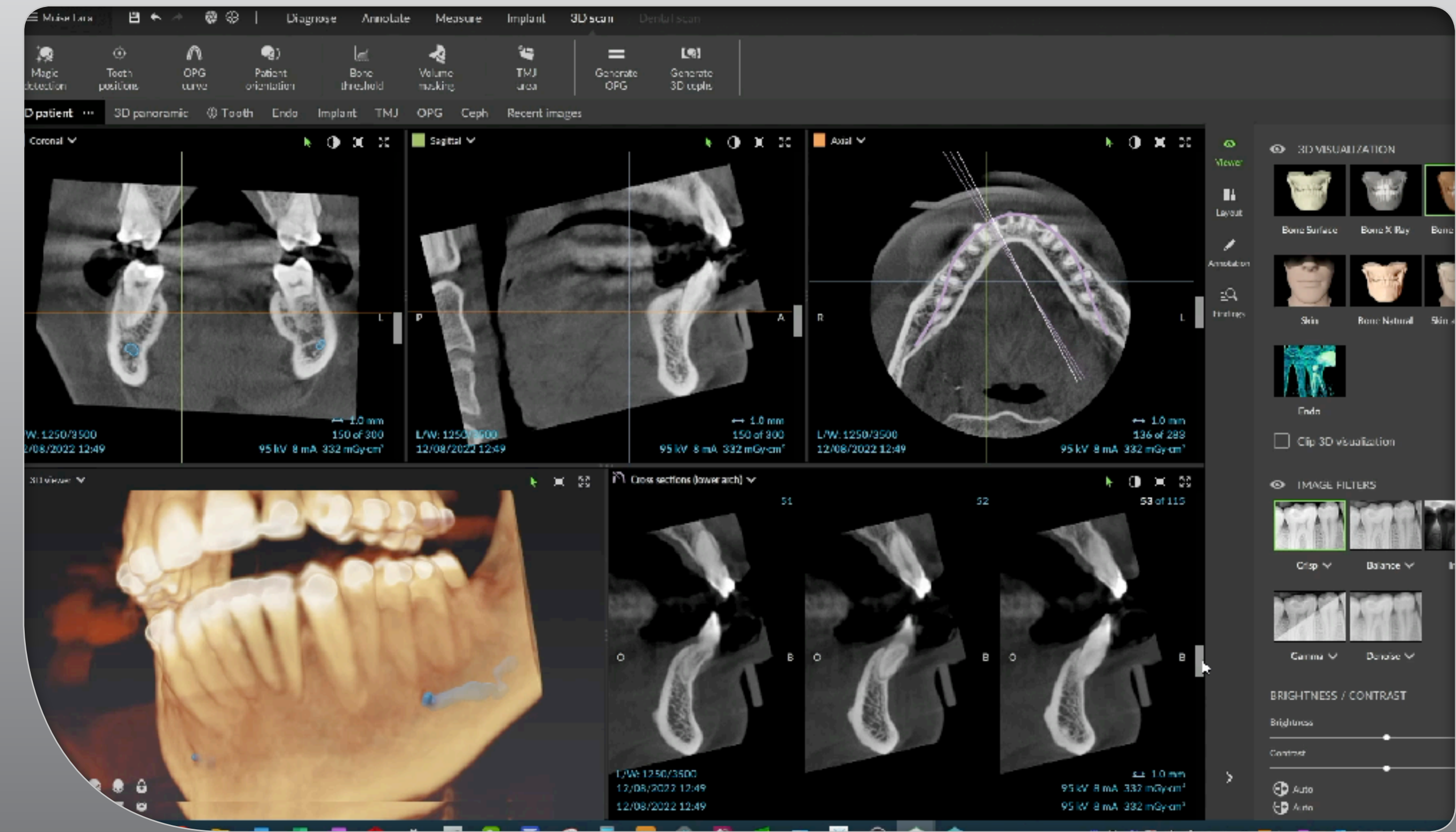
anterior mandible

- frequent tactile/thermal sensitivity/age-associated?
- challenging OH in these regions
- prior orthodontic treatment common

association with ortho?

- Renkema et al J Clin Perio 2013.
- case control study & 6 year follow-up
- ortho treated sites 4.5X more likely to develop recession (mandibular incisors 8:1 risk).

preop CBCT & site evaluation . large volume gingival augmentation . iOS tracking of treatment outcomes



Miller's 1985 classification *predicting outcomes & a bridge to therapy decisions*

Miller PD Jr. A classification of marginal tissue recession. Int J Periodontics Restorative Dent 1985;5(2):8-13.

class	preop facial tissue level	proximal soft tissue or bone level	projected root coverage
type 1	does not extend to MGJ	no soft tissue/bone level loss	100%
type 2	extends to or beyond MGJ	no soft tissue/bone level loss	100%
type 3	extends to or beyond MGJ	apical to CEJ & coronal to mid-facial FGM or tooth malposition	partial root coverage
type 4	extends beyond MGJ	apical to adjacent mid-facial FGM or tooth malposition	no /limited root coverage

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interproximal embrasure fill [bone/soft tissue]



Miller's 1985 classification *limitations* [Pini-Prato G J. Clin Perio 2011]

- 1 identification of MGJ difficult at times
- 2 residual keratinized tissue not considered
- 3 buccal recession only . does not apply to palatal recession
- 4 cannot use system to classify/document blunted papilla
- 5 predictive aspect not supported by clinical studies
- 6 predictive aspect does not match current/advanced surgical techniques

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Cairo F, Nieri M, Cincinelli S, Mervelt J, Pagliaro U. The interproximal clinical attachment level to classify gingival recessions and predict root coverage outcomes: an explorative and reliability study. J Clin Periodontol. 2011;38:661–666.

this requires that probing depths & recession need to be recorded

Recession Type 1 (RT1): Gingival recession associated with loss of interproximal attachment. The amount of interproximal attachment loss (measured from the interproximal CEJ to the depth of the interproximal pocket) is not detectable at both mesial and distal aspects of the tooth.

Recession Type 2 (RT2): Gingival recession associated with loss of interproximal attachment. The amount of interproximal attachment loss (measured from the interproximal CEJ to the depth of the interproximal pocket) is less than or equal to the buccal attachment loss (measured from the buccal CEJ to the depth of the buccal pocket).

Recession Type 3 (RT3): Gingival recession associated with loss of interproximal attachment. The amount of interproximal attachment loss (measured from the interproximal CEJ to the depth of the pocket) is higher than the buccal attachment loss (measured from the buccal CEJ to the depth of the buccal pocket).

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Cairo F, Nieri M, Cincinelli S, Mervelt J, Pagliaro U.

The interproximal clinical attachment level to classify gingival recessions and predict root coverage outcomes: an explorative and reliability study. J Clin Periodontol. 2011;38:661–666. [adopted by AAP in 2018]

class	gingival recession	interproximal attachment loss [CEJ to sulcus base (mm)]	full root coverage potential
RT1 ~ Miller class I & II	yes	no	predictable
RT2 ~ Miller class III	yes	yes interproximal < buccal	variable
RT3 ~ Miller class IV	yes	yes Interproximal > buccal	not achievable

Recession Type [RT]

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Cochrane systematic review 2018

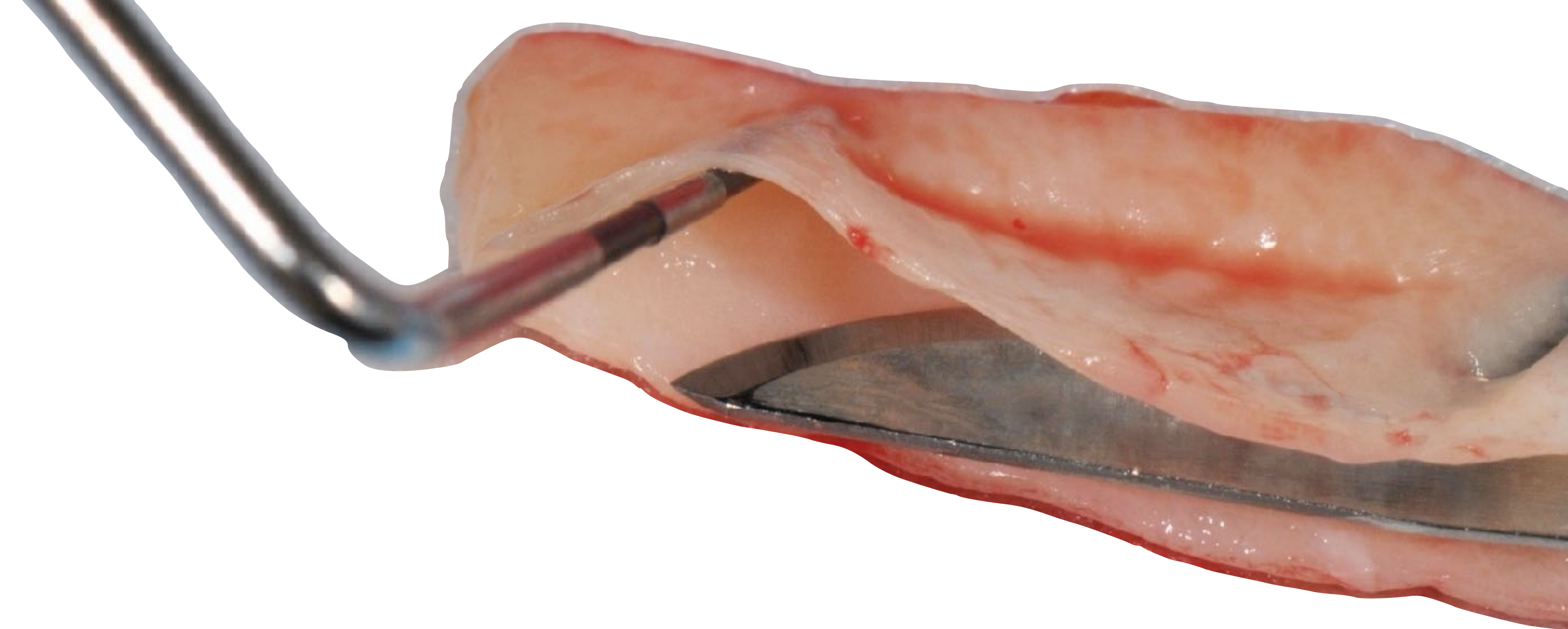
Tavelli et al J. Periodontol 2021;9:21-44.

1	FGG -recommended where increased vestibular depth, KTW & thickness is required
2	CTG -root coverage gold standard procedure . highest MRC & CRC
3	ADMG, xenogenic CM, EM protein have produced similar gains to CTG based procedures
4	ADMG (1°) & X-CM (2°) - considered suitable alternatives where CTG is not desired

outcomes not improved by root modification agents/specific root preparation methods

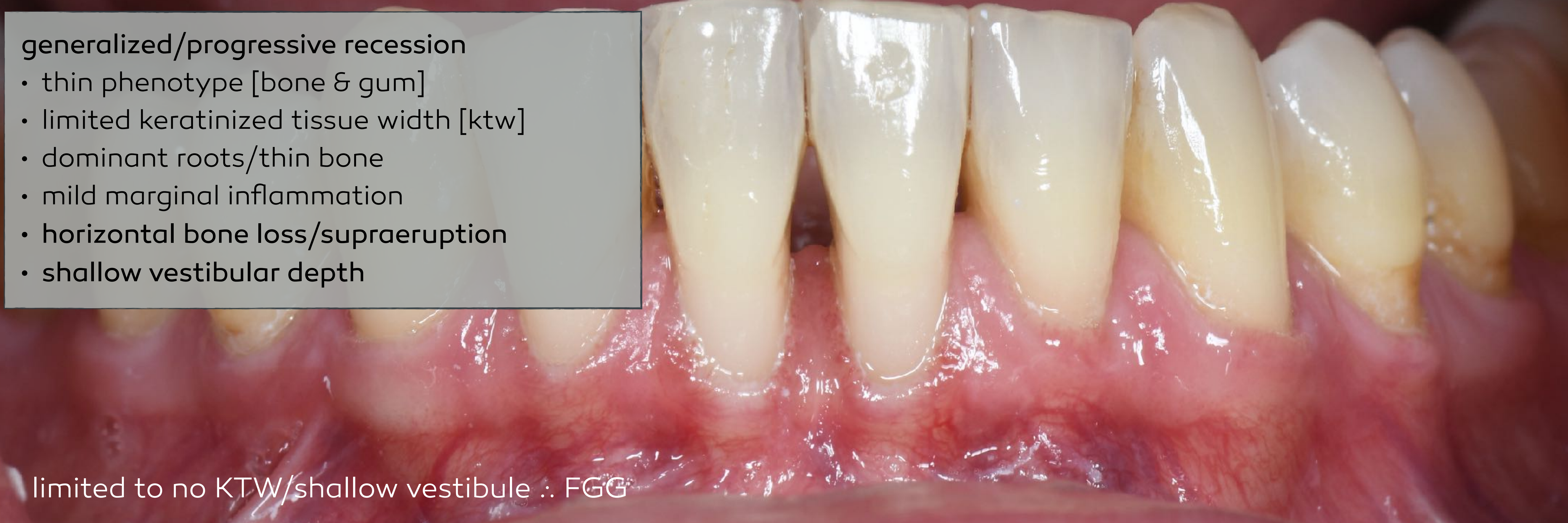
some loss of root coverage can occur over time with all procedures . relapse if <2mm KT at start

free gingival grafts





FGGs have disappeared from the esthetic zone ...
but may be indicated in esthetically irrelevant areas



generalized/progressive recession

- thin phenotype [bone & gum]
- limited keratinized tissue width [ktw]
- dominant roots/thin bone
- mild marginal inflammation
- horizontal bone loss/supraeruption
- shallow vestibular depth

limited to no KTW/shallow vestibule ∴ FG

post-op 1 year



MILLER CLASS 3-4 (CAIRO RT2-3)



preop- no root coverage expected
malpositioned roots . localized narrow papilla . horizontal bone loss pattern



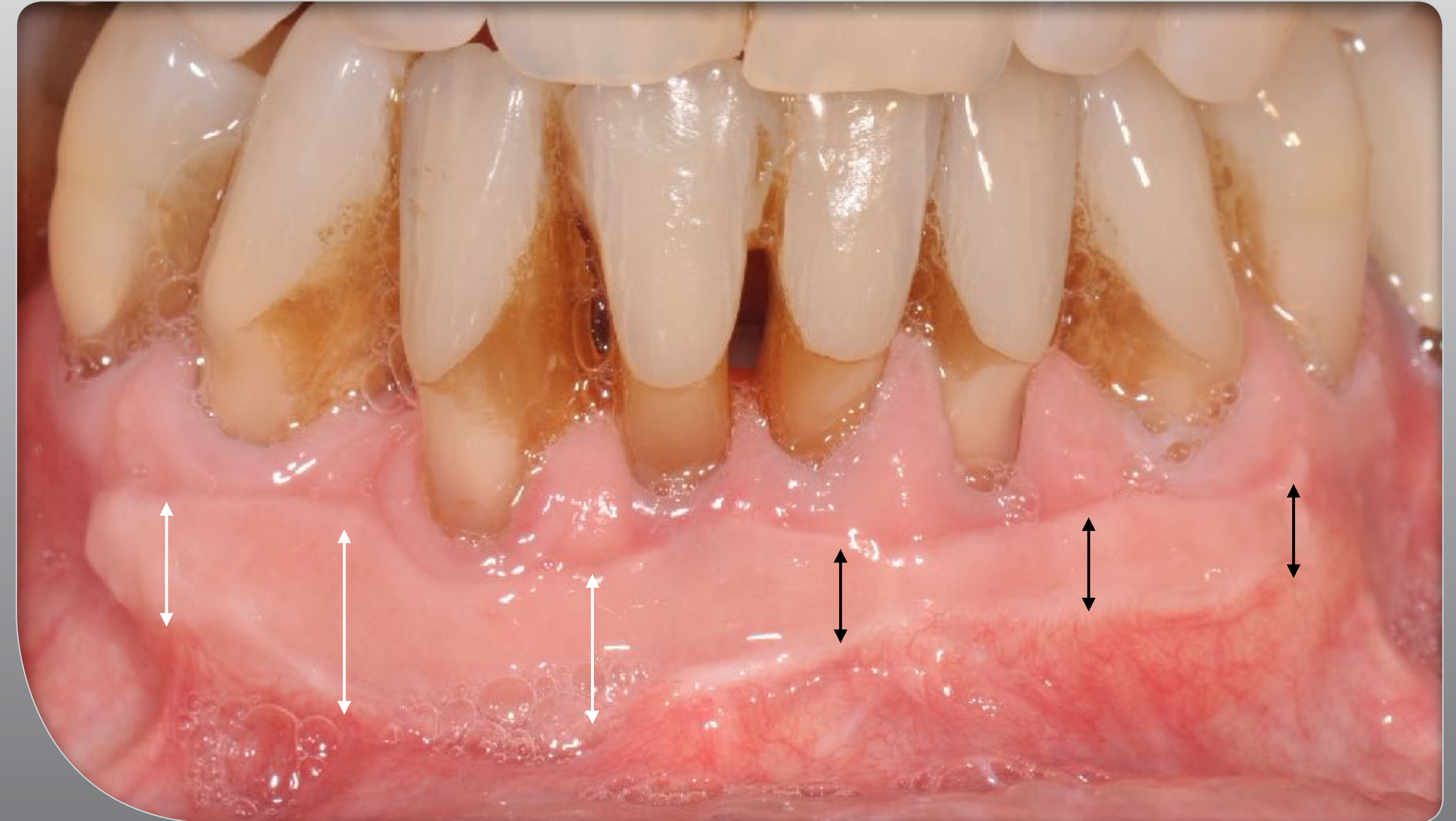
inadequate keratinized tissue width
inflammation/biofilm response & bone remodels



traditional 5+mm graft

submarginal free gingival graft

smaller 3mm 'strip graft'



2 years



thickness 1mm



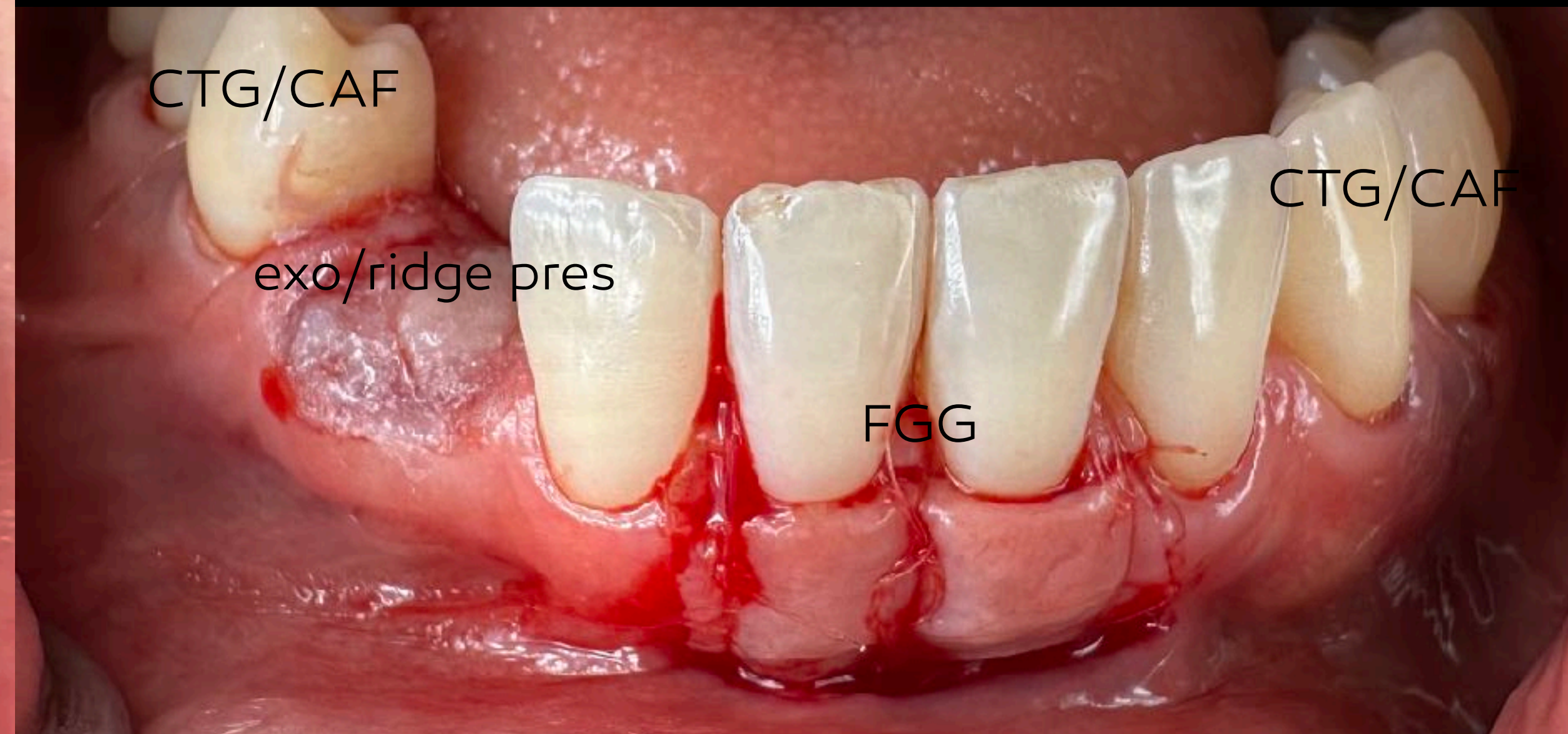


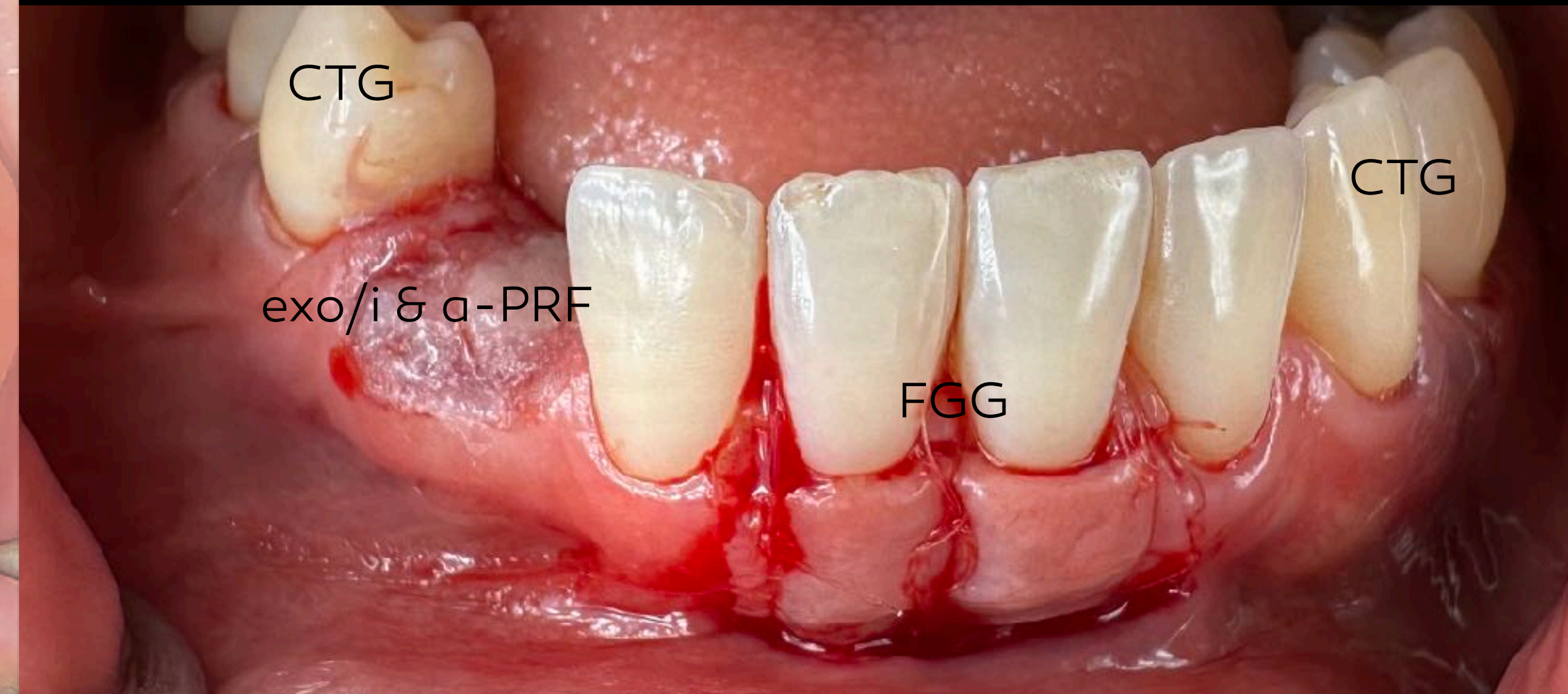
orthodontic preparation

extraction of 43- geminated root . ridge preservation
phenotype modification

root coverage/thickness augmentation - 34/35 and 44/45

KTW/KT thickness management- 31/41





Cochrane systematic review 2018

Tavelli et al J. Periodontol 2021;9:21-44.

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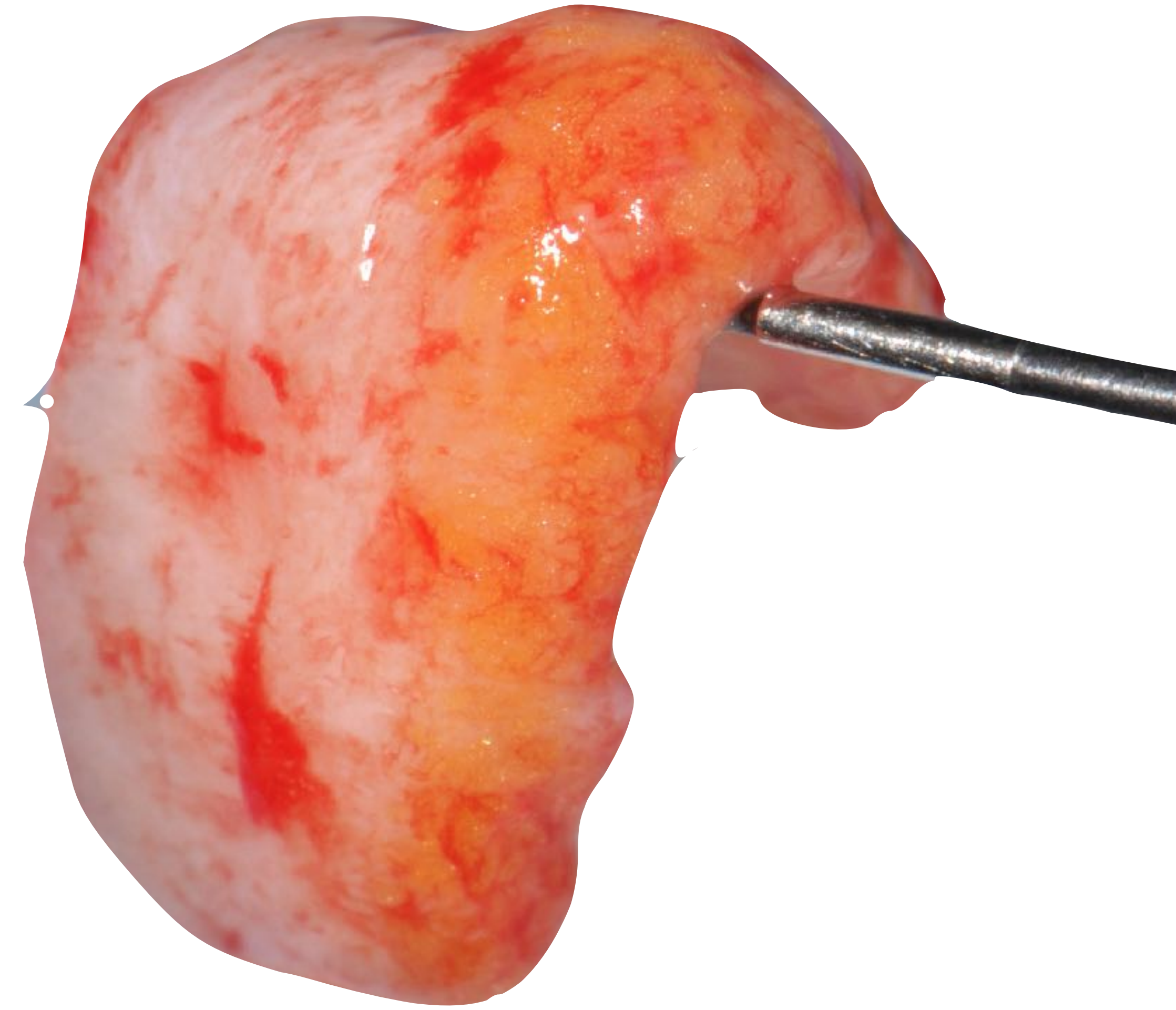
surgical technique

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connective tissue grafts





localized progressive recession

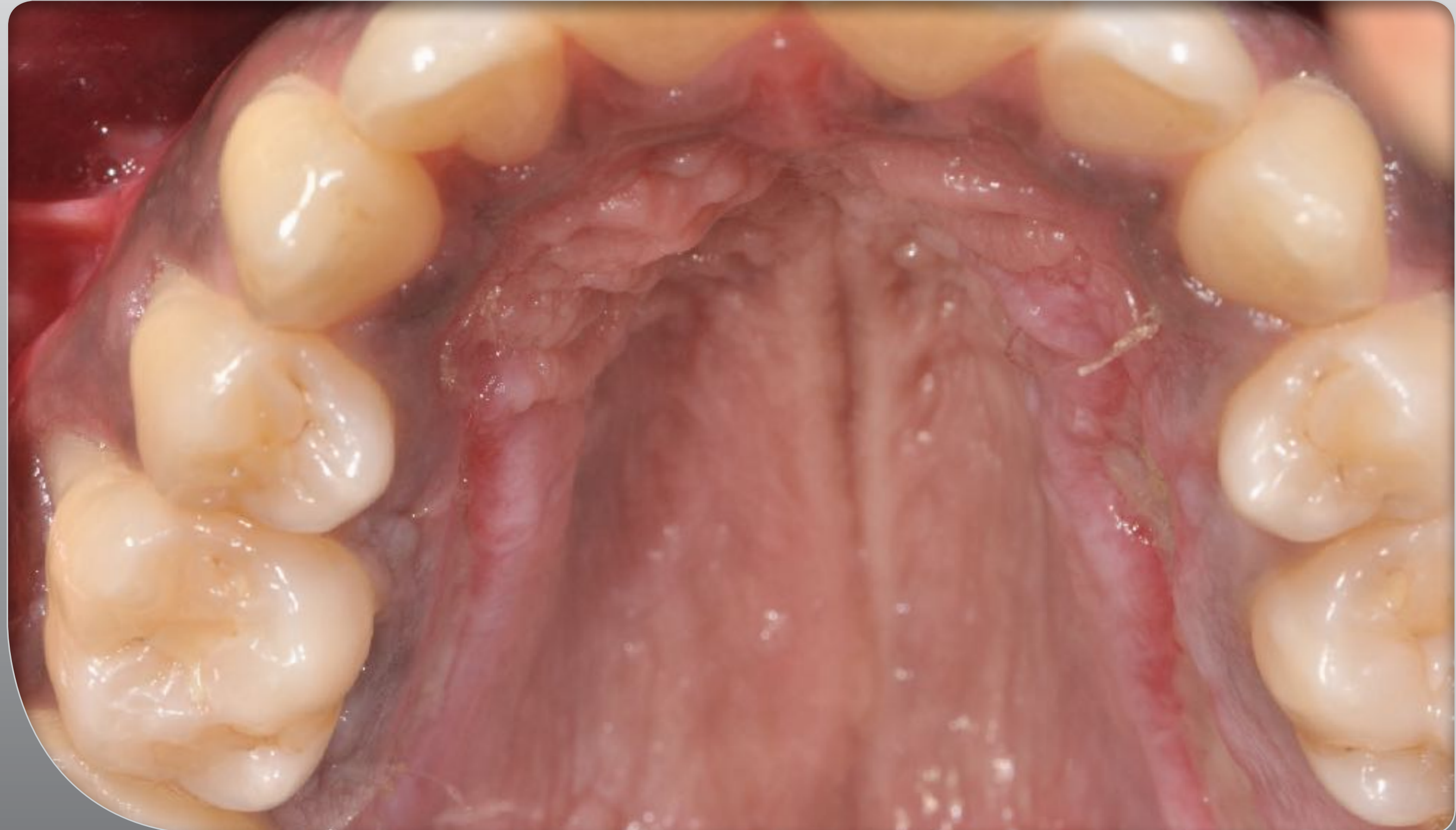
- thin phenotype
- no KT [41]
- chronic inflammation
- tissue & root sensitivity
- normal papilla/embrasure fill

is root coverage possible ? facially dominant root [41]

MILLER CLASS I (CAIRO RT1)



10 day follow-up



3 month follow-up



pre-op



CTG- 3 month follow-up



MILLER CLASS I (CAIRO RT1)

exposed & submerged deepithelized CTG



CAIRO RT1 & RT2



5 year follow-up



CASE ILLUSTRATIONS





? alternative recipient site preparation methods

envelope flap with/without releases

Bruno JF. J Perio Restorative Dent 1994;4:126-137.

Zucchelli G, De Sanctis M. J Periodontol 2000;71:1506-1514.

crestal approach coronally advanced tunnel [sharp dissection/blade prep]

Saletta D, Pini-Prato G, Pagliaro U et al. J Periodontol 2001;72:760-766.

Tavelli L, Barootchi S., Nguyen TVN et al. J Periodontol 2018;89(9): 1075-1090.

lateral (VISTA) approach coronally advanced tunnel

Zadeh HH. Int J Periodontics Restorative Dent 2011;31(6):653-60.

Gil A, Bakhshalian N, Min S, Zadeh H. J Esthet Restor Dent 2018;30(6): 572-579.

Do, JH. Int J Periodontics Restorative Dent 2019;39(2): 253-258.

apical approach coronally advanced tunnel

Chao JC. Int J Periodontics Restorative Dent 2012;32(5):521-531.

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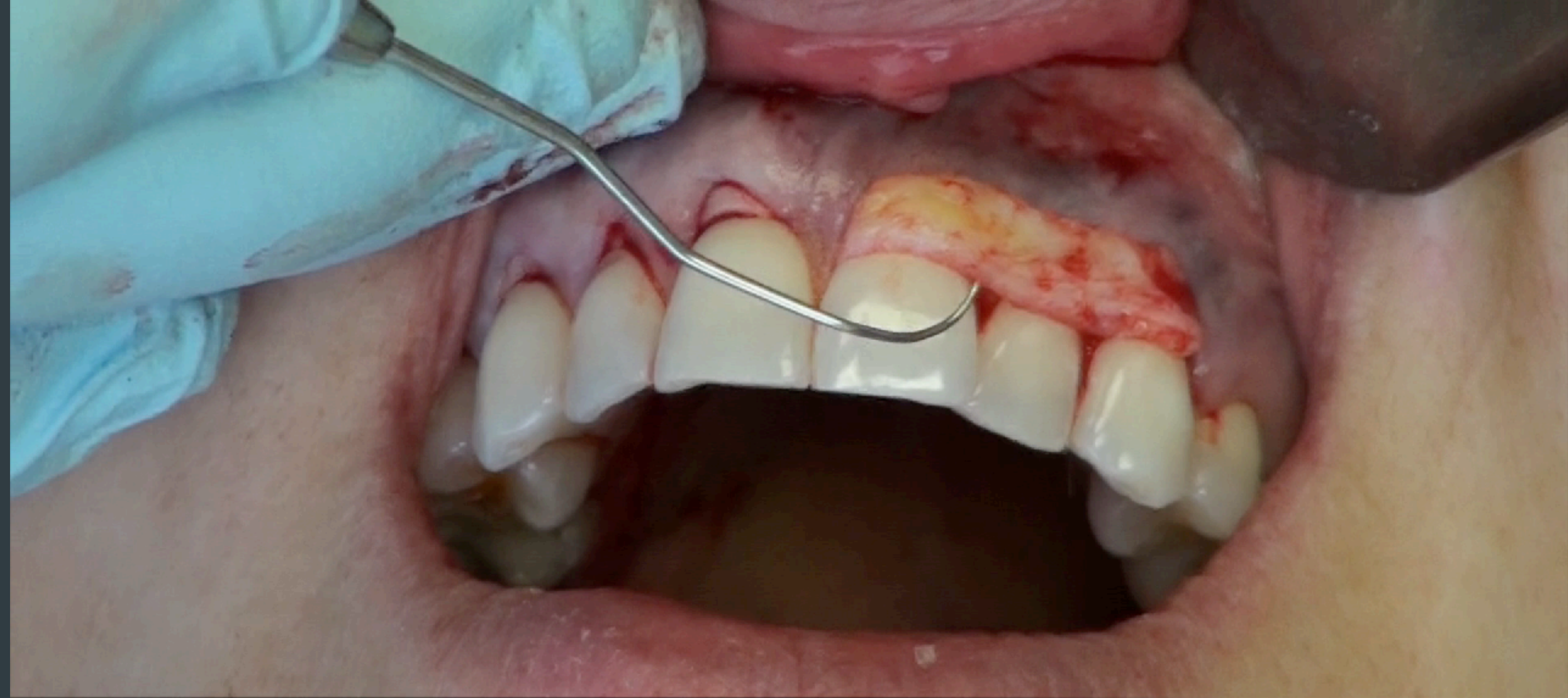
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adapting a connective tissue graft
tunnel procedure

? alternative recipient site preparation methods

envelope flap with/without releases

Bruno JF. J Perio Restorative Dent 1994;4:126-137.
Zucchelli G, De Sanctis M. J Periodontol 2000;71:1506-1514.

crestal approach coronally advanced *tunnel*

Saletta D, Pini-Prato G, Pagliaro U et al. J Periodontol 2001;72:760-766.
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lateral (VISTA) approach coronally advanced *tunnel* [blunt dissection/flap elevation]

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FLAP MANAGEMENT & root coverage

- 35% CRC - control group (split thickness)
- 80% CRC - test group (split/full/split thickness)
- association CRC & flap thickness after elevation
- presence of periosteum in the flap may be important

CRC = complete root coverage



RANDOMIZED CLINICAL TRIAL

Biologically guided flap stability: the role of flap thickness including periosteum retention on the performance of the coronally advanced flap-A double-blind randomized clinical trial

Marco Clementini✉, Nicola Discepoli, Carlotta Danesi, Massimo de Sanctis

First published: 12 August 2018 | <https://doi.org/10.1111/jcpe.12998>

ClinicalTrials.gov ID: NCT03417232.

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Abstract

Aim

To evaluate the possible benefit on wound healing and flap stability of periosteum inclusion, comparing a "split-full-split" thickness flap elevation versus a "split" thickness approach performed during CAF for the treatment of isolated-type gingival recessions in the upper jaw.

Material and Methods

Forty patients were randomized, 20 were treated with "split-full-split" (test group) and 20 with a "split" approach (control group). Analysed parameters at 1 year were CRC, percentage of recession coverage (RC), keratinized tissue (KT) gain and patient-related outcome measurements.

Results

After 12 months, CRC was 80% in the test group and 35% in the control group. Percentages of RC and KT gain were higher in the test group, and a significant association between CRC and the thickness of the flap after elevation was found. Patient-related outcomes measurements were better for the test group.

Conclusions

Flap thickness preservation and the presence of the periosteum in part of the flap may play a fundamental role in obtaining CRC.

the evolution of flap design [& material selection]

Zadeh HH. Minimally invasive treatment of maxillary anterior gingival recession defects by vestibular incision subperiosteal tunnel access and platelet-derived growth factor bb.

Int J Periodontics Restorative Dent. 2011;31:653-660.

Chao JC. A novel approach to root coverage: the pinhole surgical technique.

Int J Periodontics Restorative Dent. 2012; 32(5): 521-531.

mucosal tunnel access points



CTG- superficial harvest



14 days



14 days



6 months post-op





tuberosity graft

* risk for hyperplasia

KEY ...graft quality . harvesting methods

Suarez-Lopez F et al. Influence of soft tissue thickness of peri-implant marginal bone loss: A systematic review and meta-analysis. *J Perio* 2016;87(6): 690-699.

Bertl K, Pifl M, Hirtler L et al. Relative composition of fibrous connective and fatty/glandular tissue in connective tissue grafts depends on the harvesting technique but not the donor site of the hard palate. *J Periodontol*. 2015;86(12):1331-1339.

Heil A, Schwindling FS, Jelinek C et al. Determination of the palatal masticatory mucosa thickness by dental MRI: a prospective study analyzing age and gender effects. *Dentomaxillofac Radiol* 2017.

Tavelli L, Barootchi S, Greenwell H et al. Is a soft tissue graft harvested from the maxillary tuberosity the approach of choice in an isolated site? *J Periodontol*. 2019;90:821-825.

bulky/hyperplastic grafts 13/23
recession/esthetic concerns 12-22

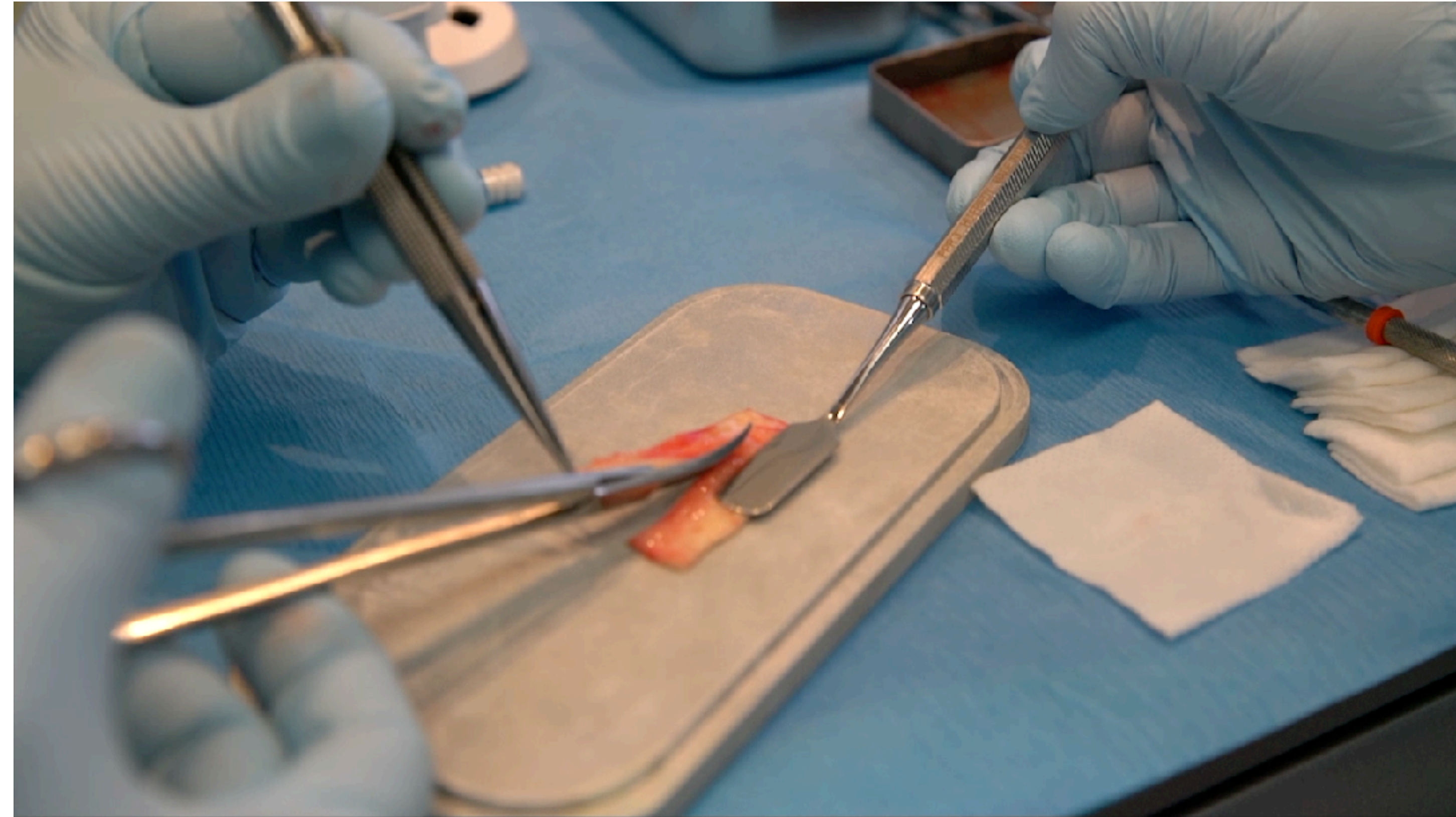


gingivoplasty grafts 13/23
4mm high/1.25mm thick CTG 12-22



why ADMG substitutes - skin grafts?

large number of teeth to treat
palate anatomy limitations
avoid donor site side-effects/complications
patients who do not want palatal harvest
market pressures



acellular dermal matrix graft



dermal/reticular side
larger pores/absorbs blood
[orientation: towards flap]



basement membrane/papillary side
smaller pores/repels blood
[orientation: towards bone]

tissue engineering strategies/signaling molecules

[biologic mediators . promote chemotaxis, proliferation, differentiation]

- PDGF-bb
- EMD
- autogenous PRF-based [not a lot of literature to date]

combined with soft-tissue scaffold

epithelial/fibroblast scaffold - natural porosity, vessel channels, basement membrane
promote migration/colonization of host cells . durable . immunologically inert

- signaling factors ↑ mean root coverage. KT width gain, thickness gain
- accelerate cell migration & scaffold colonization
- faster healing/higher volume stability

Tavelli L, Barootchi S, Rasperini G, Giannobile WV. Clinical and patient-reported outcomes of tissue engineering strategies for periodontal and peri-implant reconstruction. *Periodontology* 2000; 2023;91:217-269.



CASE ILLUSTRATION



miller class III / cairo RT2 . prior to class V removals



recipient site preparation

- scale to remove calculus
- plaque and biofilm . polish with pumice . now ideally with EMS airflow
- modify root convexity with rotary instrumentation if necessary
- remove caries or class V restorations
- no evidence for root surface bio-modification (etching with ttc, citric acid, EDTA)

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set of 4 tunnelling instruments . available from www.pronorthmedical.ca



'arc' acellular dermal matrix graft

Leziy S, Miller B. Acellular dermal tissue augmentation procedures for teeth and implants: the dermal ARC protocol. Manuscript in preparation.



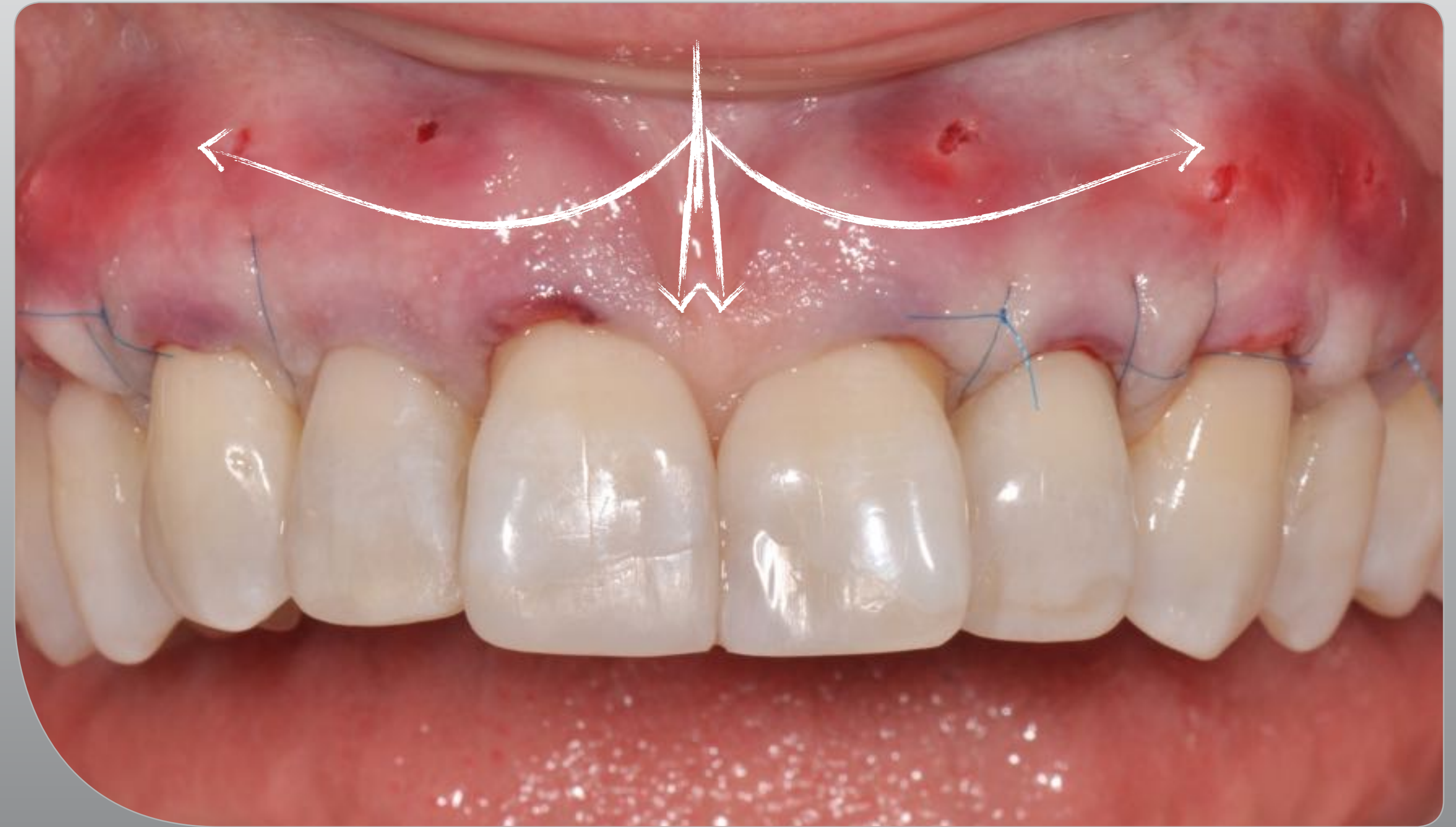
acellular dermal matrix graft
mucosal access/coronal flap advancement



full thickness apico-coronal tunnelling
apical access points

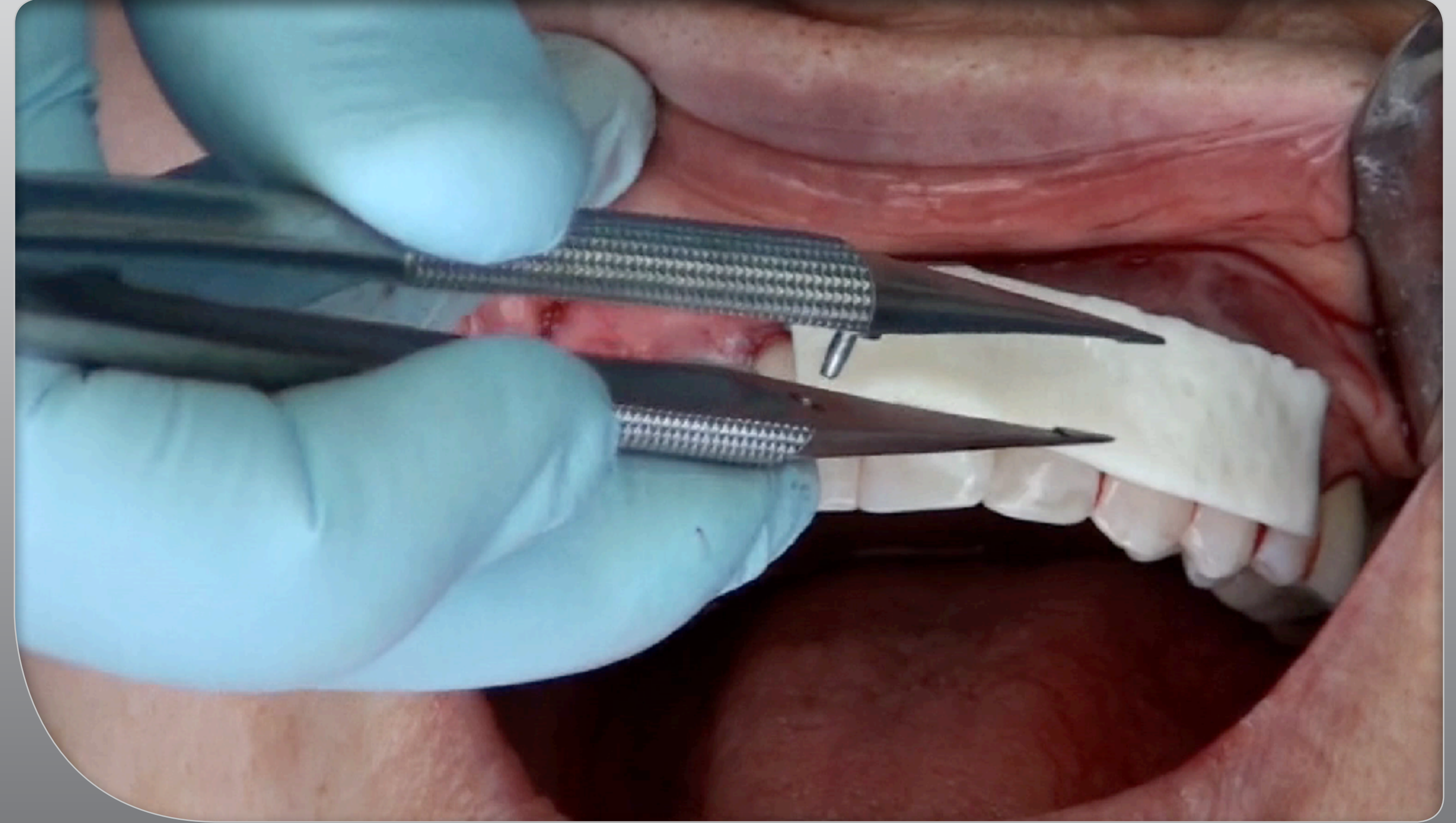
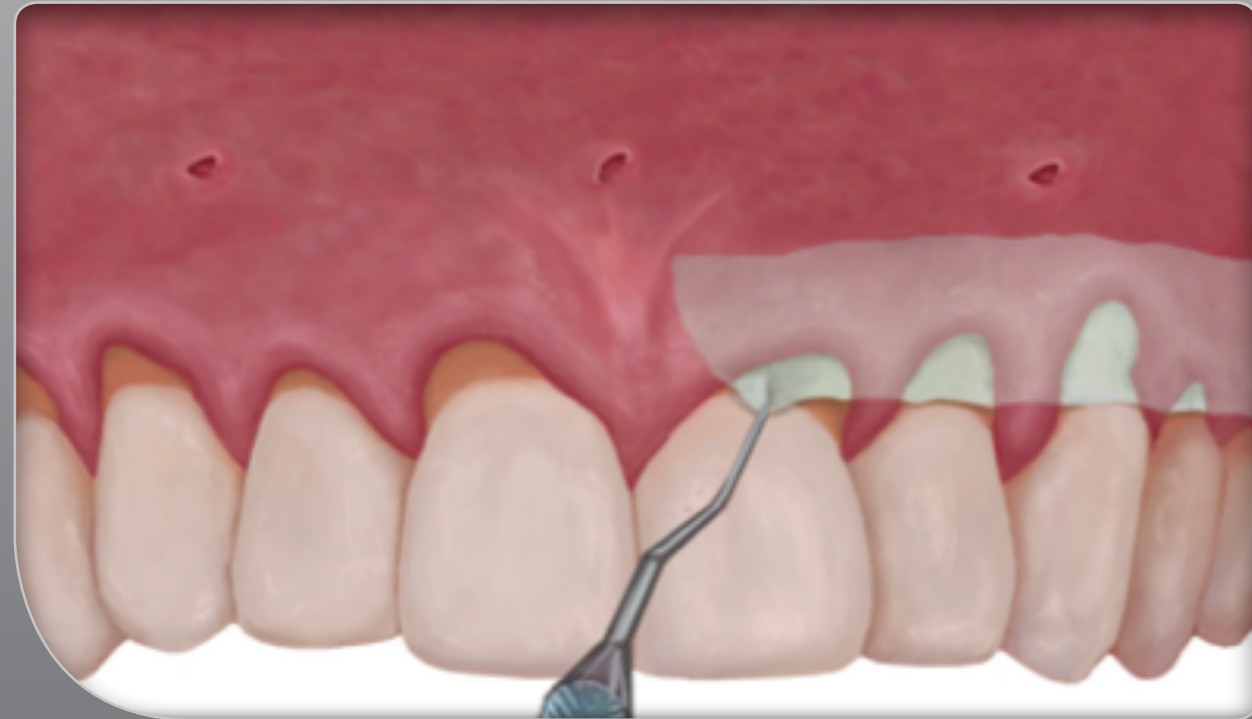
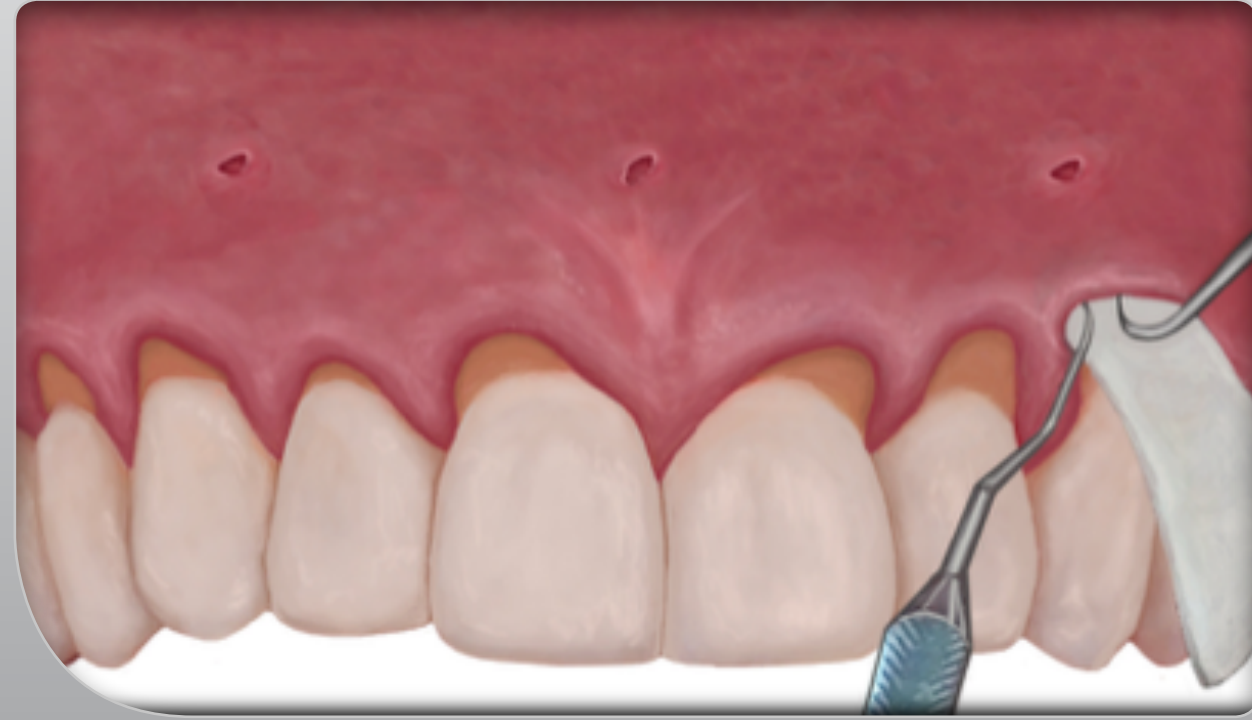


full thickness lateral tunnelling
'VISTA' incision



reticular (dermal) - larger pores/absorbs blood

papillary (basement membrane)- dull/small pores/repels blood



pre-op



2 year post-op



CASE ILLUSTRATION



postop

straumann acellular dermal matrix allograft



the types of results that are possible

CASE ILLUSTRATION



CASE ILLUSTRATION



the types of results that are possible

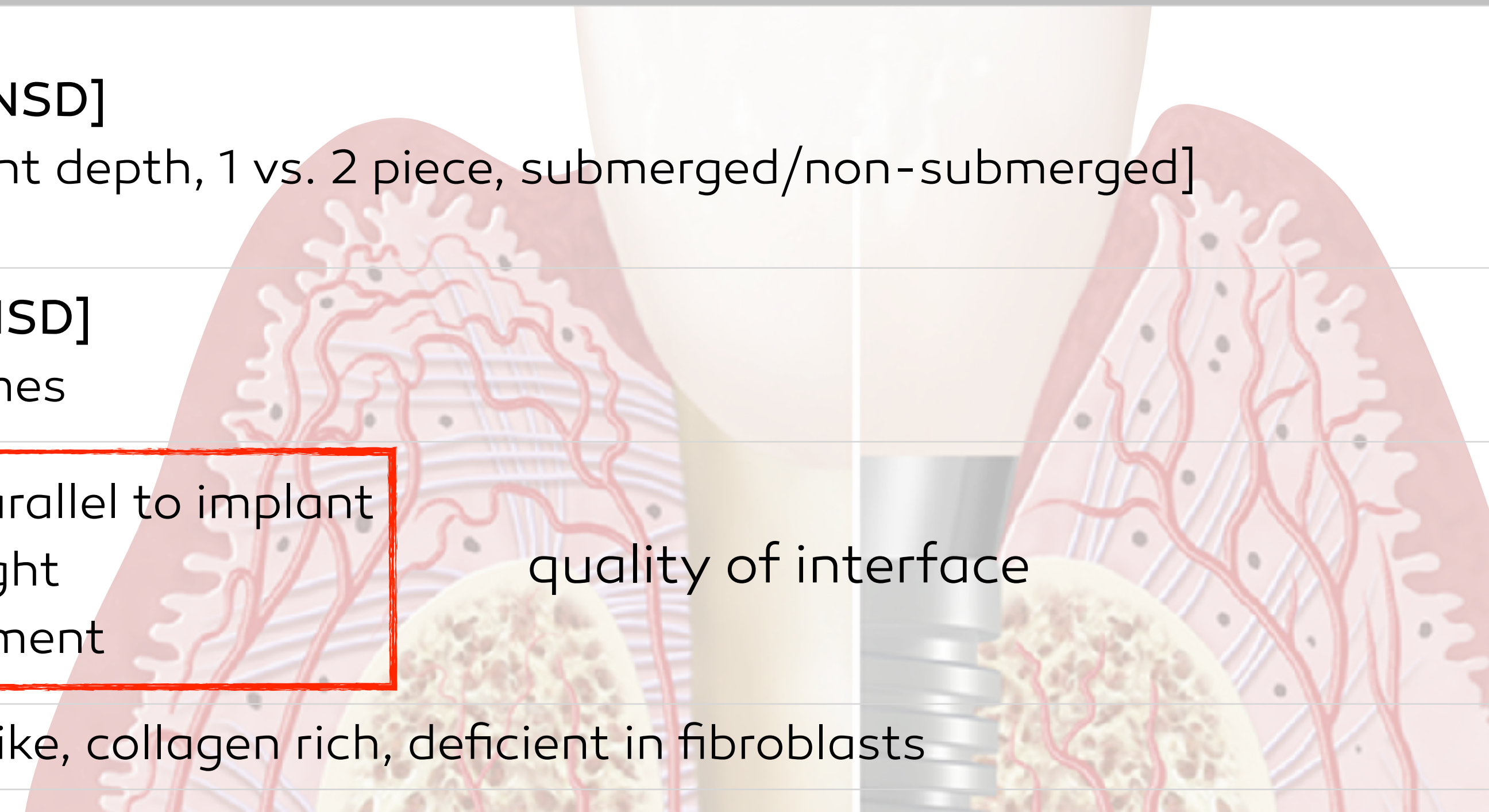


periodontal vs peri-implant soft tissues

Berglundh et al 1991
Buser et al 1992
Weber et al 1996
Herman et al 2001
Sculean et al 2014

features	periodontium	peri-implant tissue
supracrestal soft tissue [biologic width]	mean 3.17mm shallow	mean 3.8mm [NSD] variable [implant depth, 1 vs. 2 piece, submerged/non-submerged]
junctional epithelium	mean 2mm hemidesmosomes	1.3 to 1.8mm [NSD] hemidesmosomes
connective tissue attachment	perpendicular to root	longitudinal/parallel to implant greater CT height weaker attachment
vascularity	extensive	limited - scar-like, collagen rich, deficient in fibroblasts

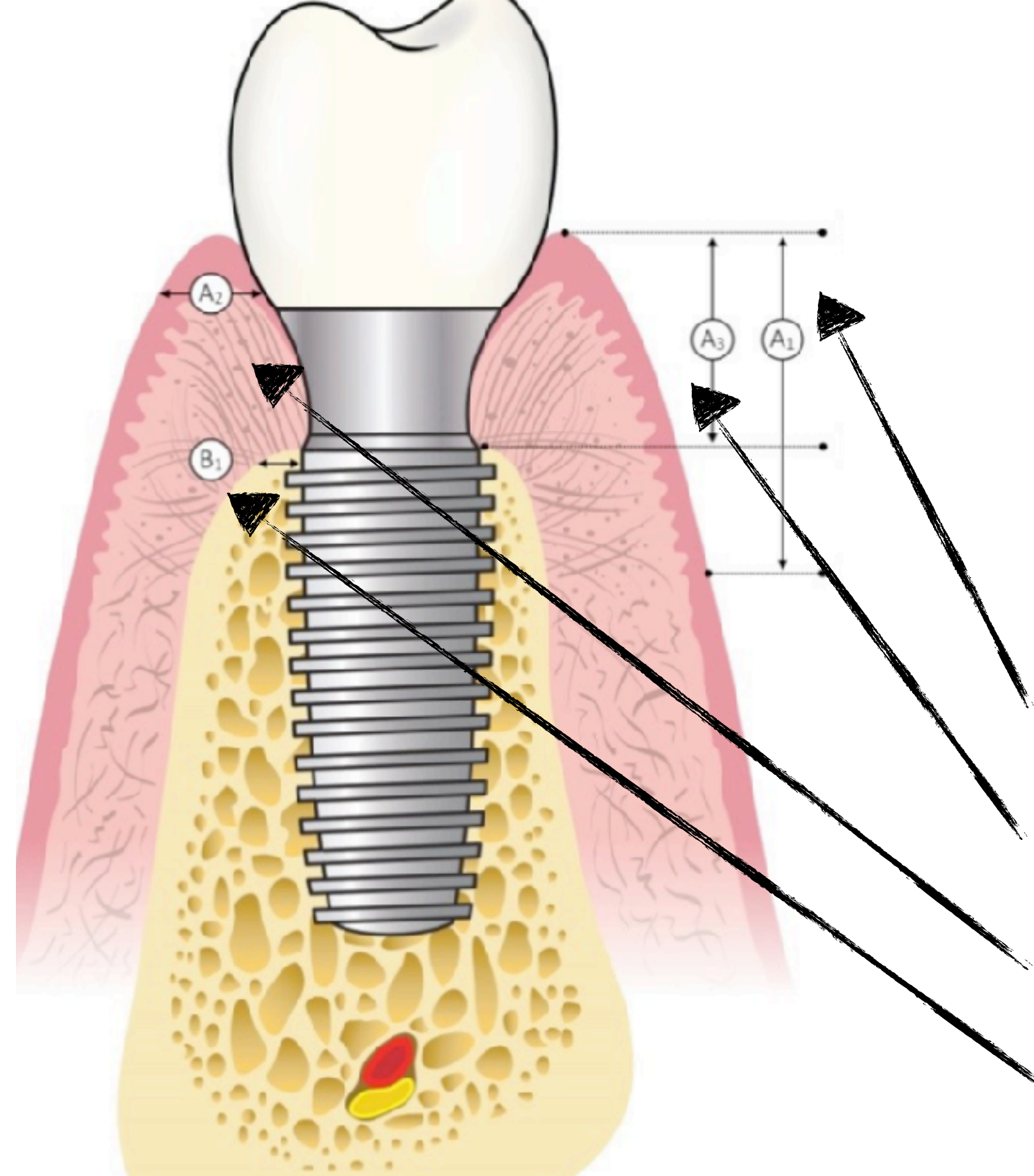
quality of interface



peri-implant phenotype

illustration from

Avila-Ortiz G, Gonzalez-Martin O, Couso-Queiruga E, Wang H-L. J Periodontol 2020



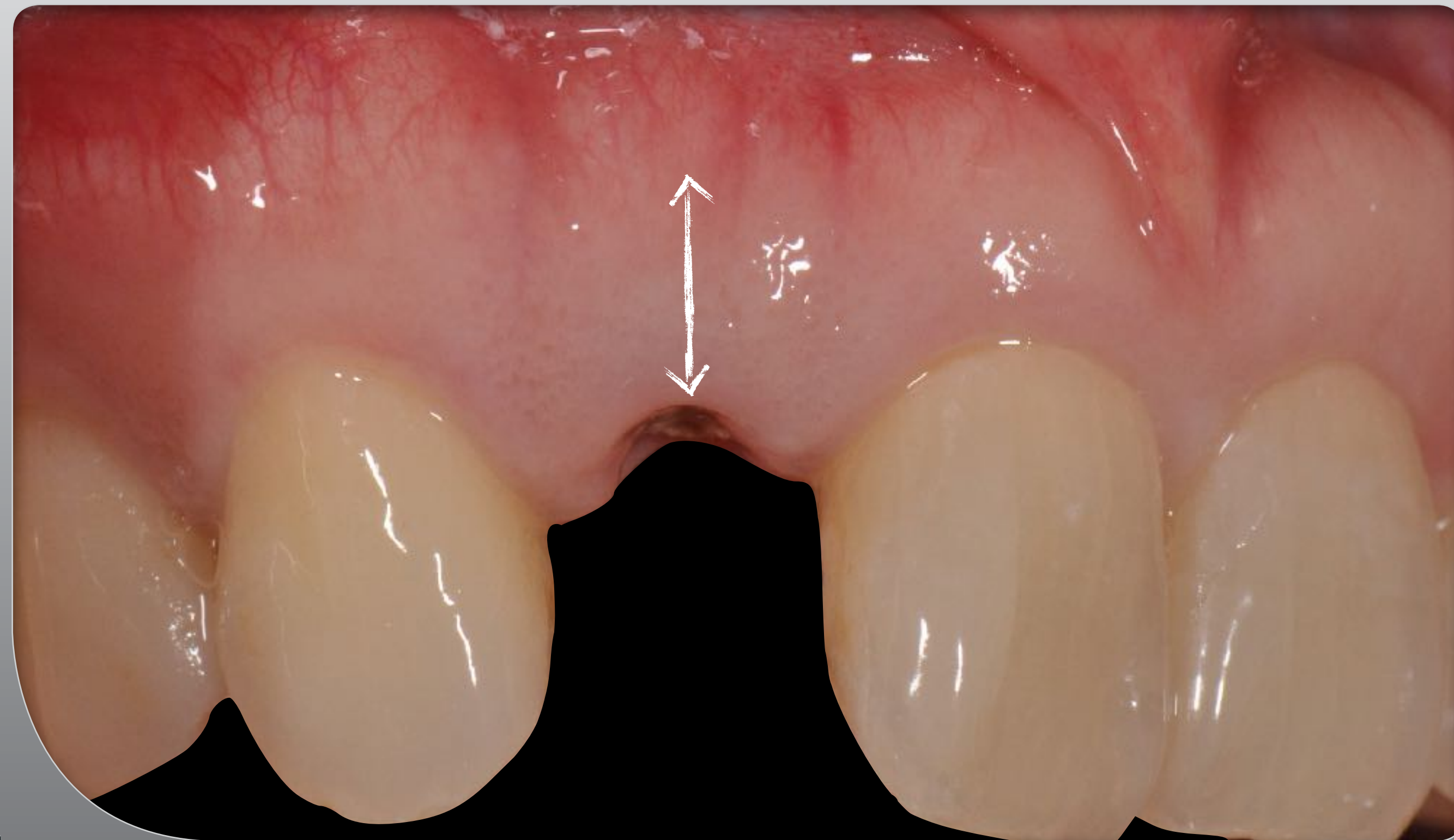
impact on tissue stability, esthetics, health

soft tissues & bone morphotype

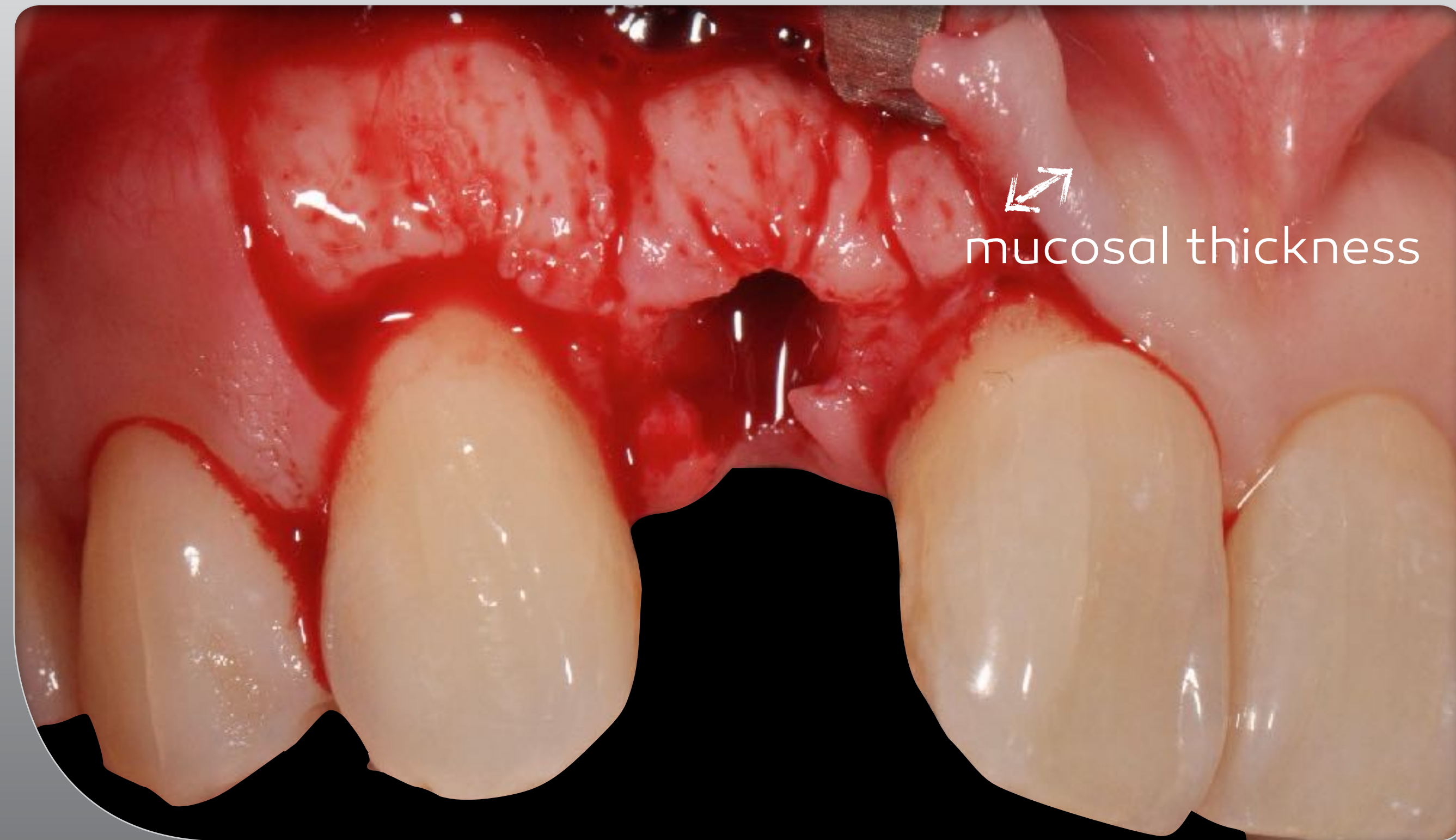
1. keratinized mucosa width (**inadequate <2mm**) ↑ mucositis/bone remodelling
2. supracrestal tissue height (**short <3mm**) ↑ physiologic marginal bone loss
3. mucosal thickness (**thin <2mm**) aesthetic concerns & ↑ interproximal bone loss
4. peri-implant bone thickness (**thin <2mm**) ↑ vertical bone loss/failure



keratinized tissue width . gingival margin → MGJ



thick bone morphotype threshold >1mm
assessed by flap or CBCT



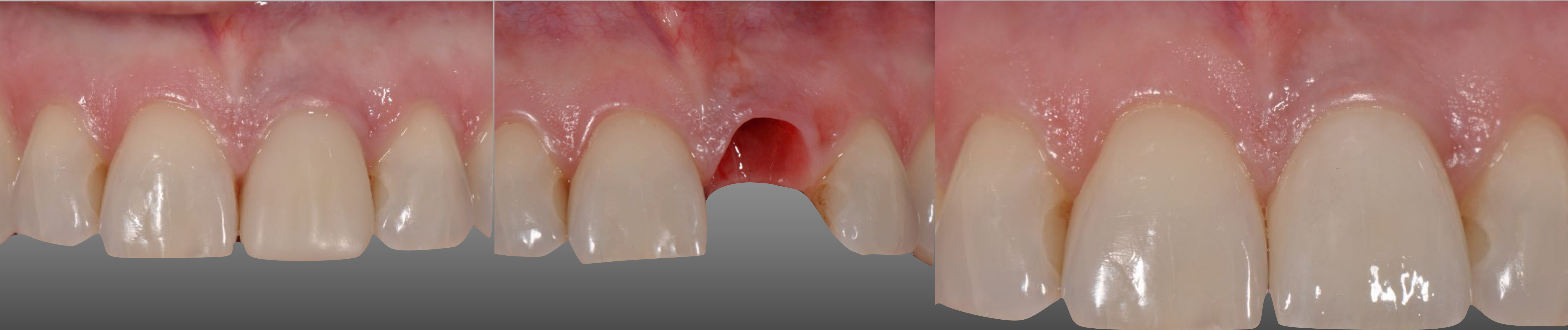
mucosal thickness





COLOUR

stable tissue but minimal KT thickness . transmucosal color impact



post-op 3 years



thick morphotype/favourable ridge
thin tissue phenotype



N

pre-op

natural tooth veneered
to temp abutment

immediate post-op

post-op 12 weeks

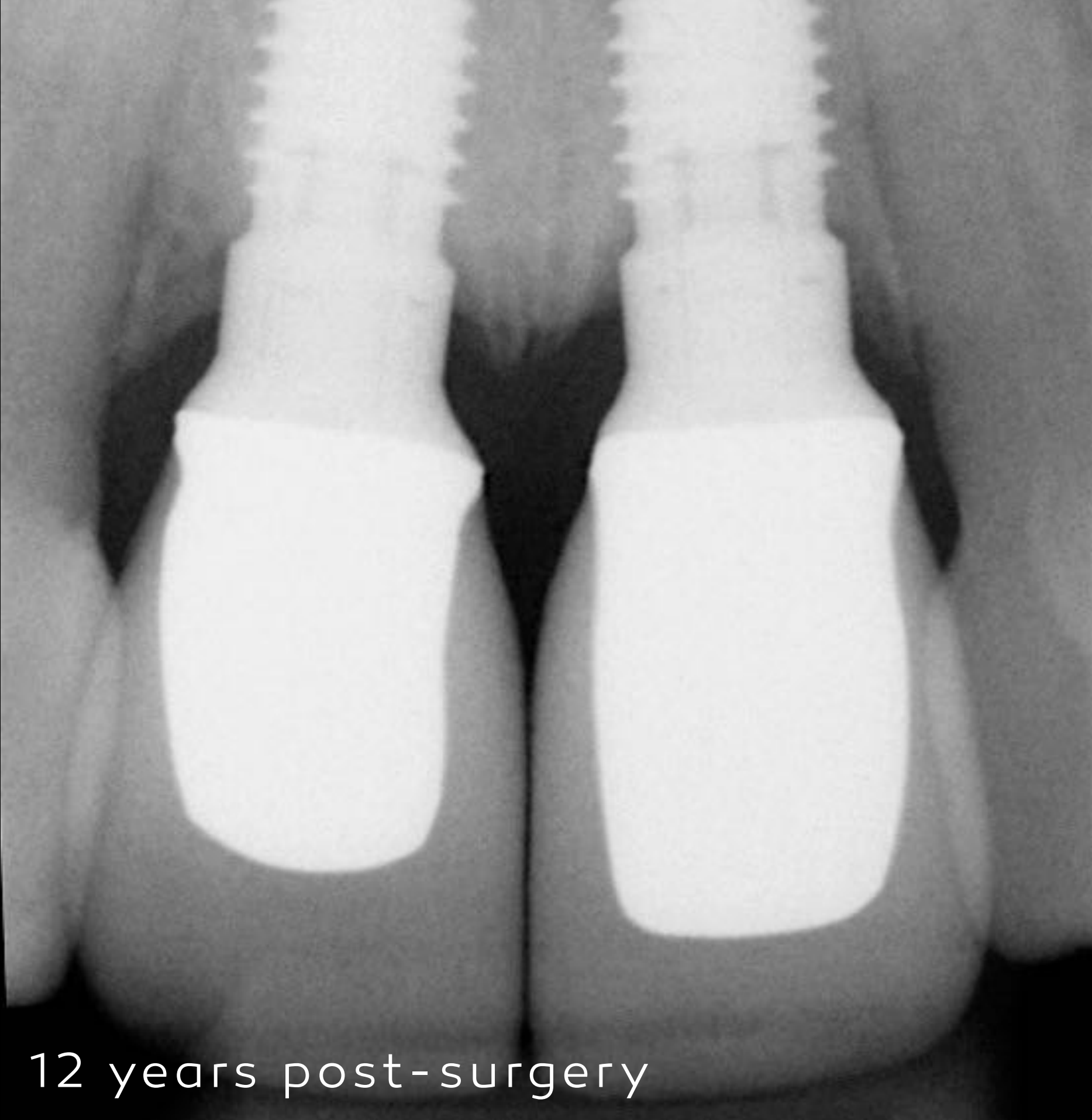
key points considered to optimize tissue level

- limit papilla-opening procedures
- smaller implant diameters to \uparrow facial bone volume
- idealize 3d implant position/facial bone volume
- critical/subcritical provisional restoration contours
- contact point positions



- 1 pre-op
- 2 4 years post-op palatal
- 3 mild biofilm-mediated inflammation 13/11





12 years post-surgery



inadequate bone grafting . KT thickness . adjacent implant placement . implant diameters . connection type . transmucosal material



4 years after remediation

implants - rationale for augmenting the soft tissues

KAM = keratinized attached mucosa

clinical trials
[inadequate KAM <2mm]

- ↑ risk for inflammation
- ↑ bleeding scores & plaque buildup
- ↑ risk for hard/soft tissue loss

Warrer et al 1995, Block et al 1996

Roccuzzo et al 2016

Zigdon et al 2008, Schrott et al 2009, Lin et al 2013, Crespi et al 2010, Perussolo et al 2018

reviews
[adequate KAM >2mm]

- ↓ plaque accumulation
- ↓ recession . better soft tissue stability
- ↓ mucositis incidence

Sculean et al 2017

Chrcanovic et al 2017, Chackartchi et 2019

Iorio-Siciliano et al 2019

systematic reviews
[impact of autogenous grafts]

- ↓ bleeding scores, ↓ marginal bone loss
- better colour/esthetics . 2mm threshold
- ↓ recession - immediate, minimum/no facial bony walls, orofacial implant malposition

Thoma et al 2018a

Jung et al 2007, Cosgarea et al 2015, Ioannidis et al 2017

Buser et al 2004, Evans et al 2008, Sculean et al 2017



absent/deficient KTM & peri-implant disease



risk indicator - peri-implant disease [Gharpure et al 2022]
erratic compliance & peri-implantitis [Monje et al 2018]



impact of inadequate KT width [$<2\text{mm}$]

peri-implant health

FGG/APF > ADM > CTG > CM > APF > no trt.

outcomes

- ↑ mucosal seal/adaptation to transmucosal components
- ↓ PD/bone loss, recession
- ↓ plaque index, inflammation [PGE₂, IL-1B, TNF α], brushing discomfort

Oh SL, Masri RM, Williams DA, Ji C, Romberg E. J Clin Periodontol. 2017; 44: 195-203.

Giannobile WV, Jung RE, Schwarz F. Clin Oral Implants Res 2018;29 (suppl 15): 7-10.

Perussolo J, Souza AB, Matarazzo F et al. Clin Oral Implants Res. 2018; 29: 1177-1185.

Monje A et al. 2022

Tavelli L, Barootchi S, Avila-Ortiz G et al. Peri-implant soft tissue phenotype modification and its impact on peri-implant health: A systematic review and network meta-analysis. J Perio 2021;92:21-44.

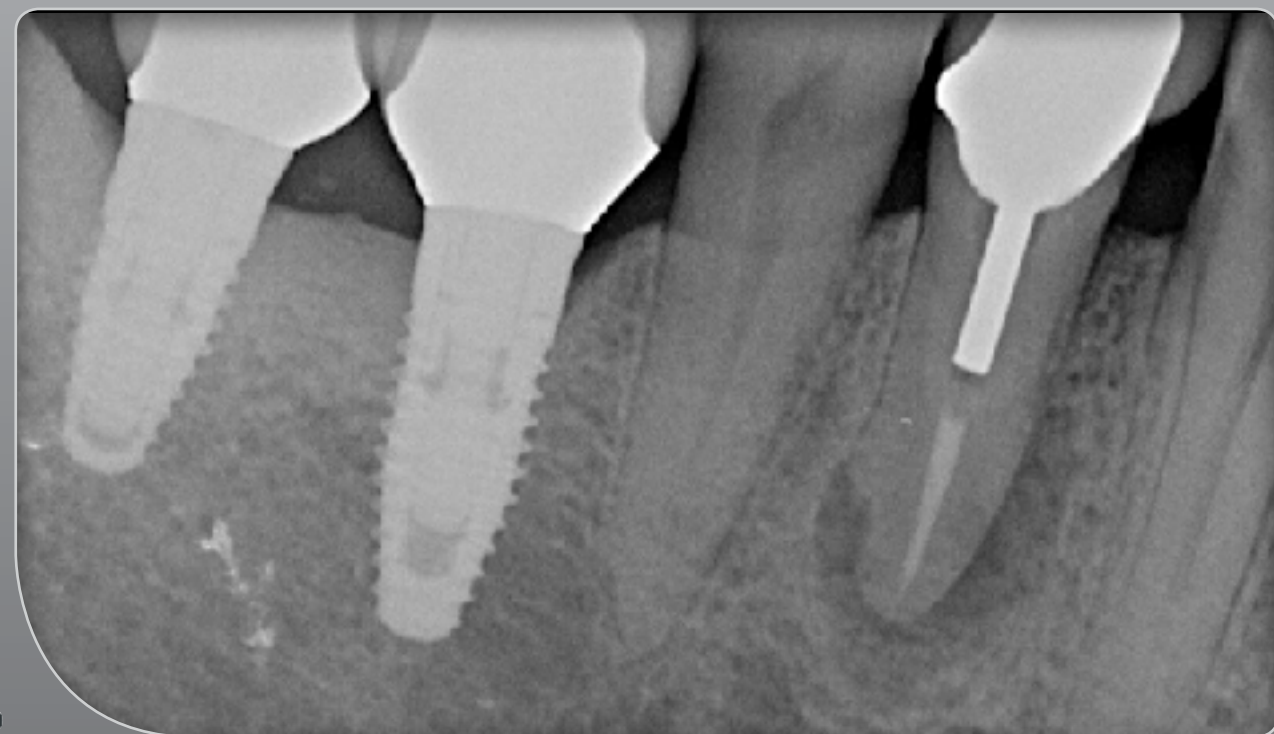




Oh SL et al 2017 & 2020. FGG \uparrow KM width \downarrow GI, MBL & recession

- 1 pre-operative - 44 (28) root fracture
- 2 post-extraction 3 months - occlusal
- 3 marginal free gingival graft prior to extraction

1.



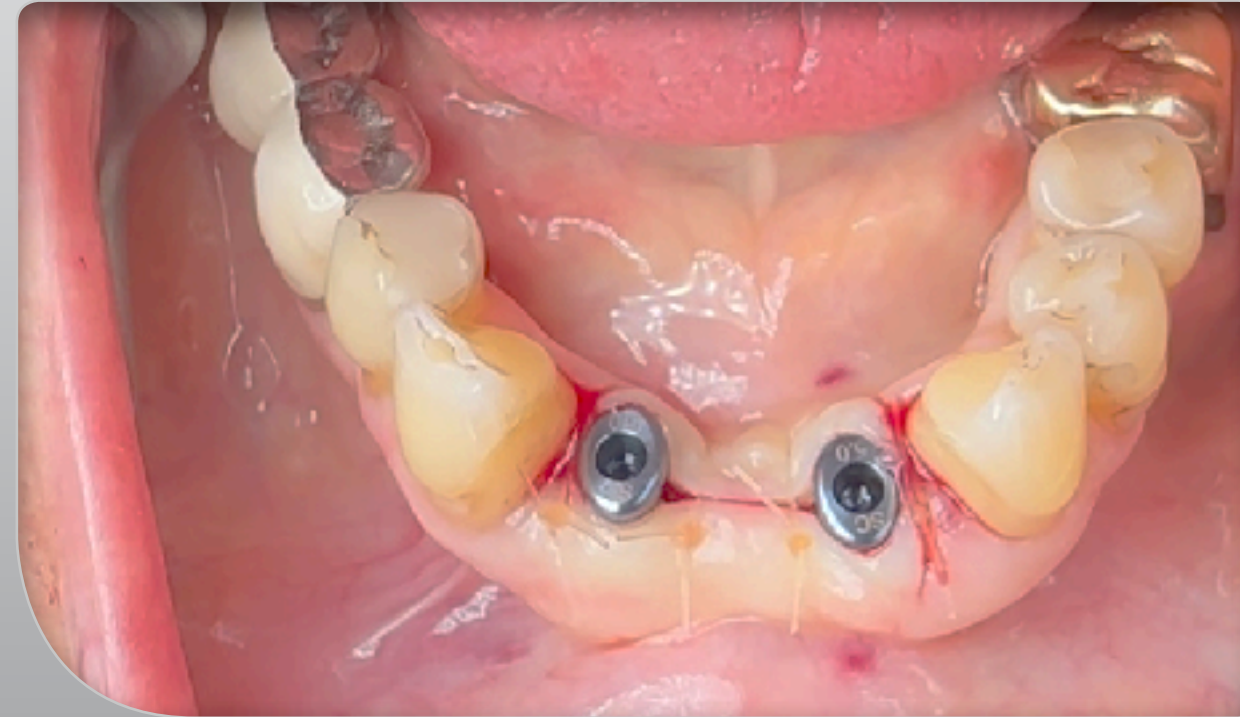
2.



3.



FGGs - site preparation for implants



- facilitate OH procedures
- improve patient comfort
- reduce tissue inflammation
- decrease recession/attachment loss
- protect bone

Lin GH, Chan HL, Wang HL. J Periodontol 2013.

Roccuzzo M, Grasso G, Dalmaso P. Clin Oral Implants Res. 2016.

Giannobile WV, Jung RE, Schwarz F. Clin Oral Implants Res. 2018.

Thoma DS, Naenni N, Figure E et al. Clin Oral Implants Res. 2018.

Bilaminar techniques

autogenous - connective tissue graft

allograft - acellular dermal matrix graft

xenograft- collagen matrix graft

non-augmented sites

no KM width gain with any treatments

mucosal thickness gain **CTG & ADMG > CM**

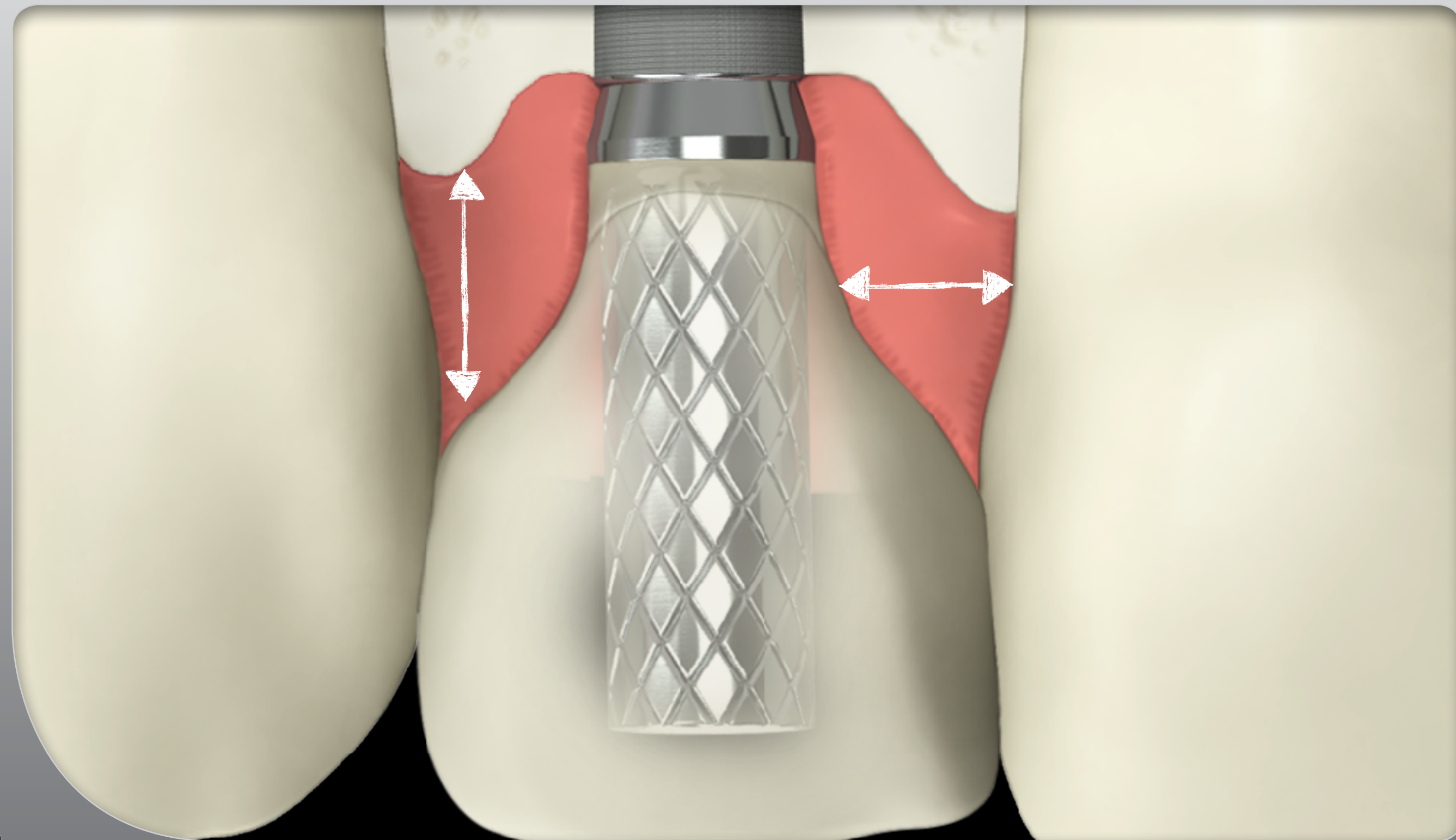
bone stability CTG & CM +ve effect

- thickness of the mucosa ?
 - < 2mm thickness transmucosal abutment impacts colour
 - ≥ 2 mm target thickness for esthetic/colour goal & health





- moderately thick gingival phenotype
- facial tissue recession - esthetic risk factor
- adequate palatal & apical bone for stability
- ideal M-D space/root alignment/proximal bone
- adjacent restorations - esthetic risk factor
- favourable occlusion . cooperative patient





R

- De Rouck T, Collys K, Wyn I, Cosyn J. Instant provisionalization of immediate single-tooth implants is essential to optimize esthetic treatment outcomes. *Clin Oral Implants Res.* 2009. 20(6):566-570
- Cosyn J, Eghball A, De Bruyn H, Collys K, et et. Immediate single-tooth implants in the anterior maxilla: 3-year results of a case series on hard and soft tissue response and aesthetics. *J Clin Periodontol* 2011;38(8):746-753.
- Peng M, Fei W, Hosseini M, Gotfredsen K. Influence of implant position on clinical crown length and peri-implant soft tissue dimensions at implant-supported single crowns replacing maxillary central incisors. *Int J Periodontics Restorative Dent.* 2013;33(6):785-793.



deficient distal papilla

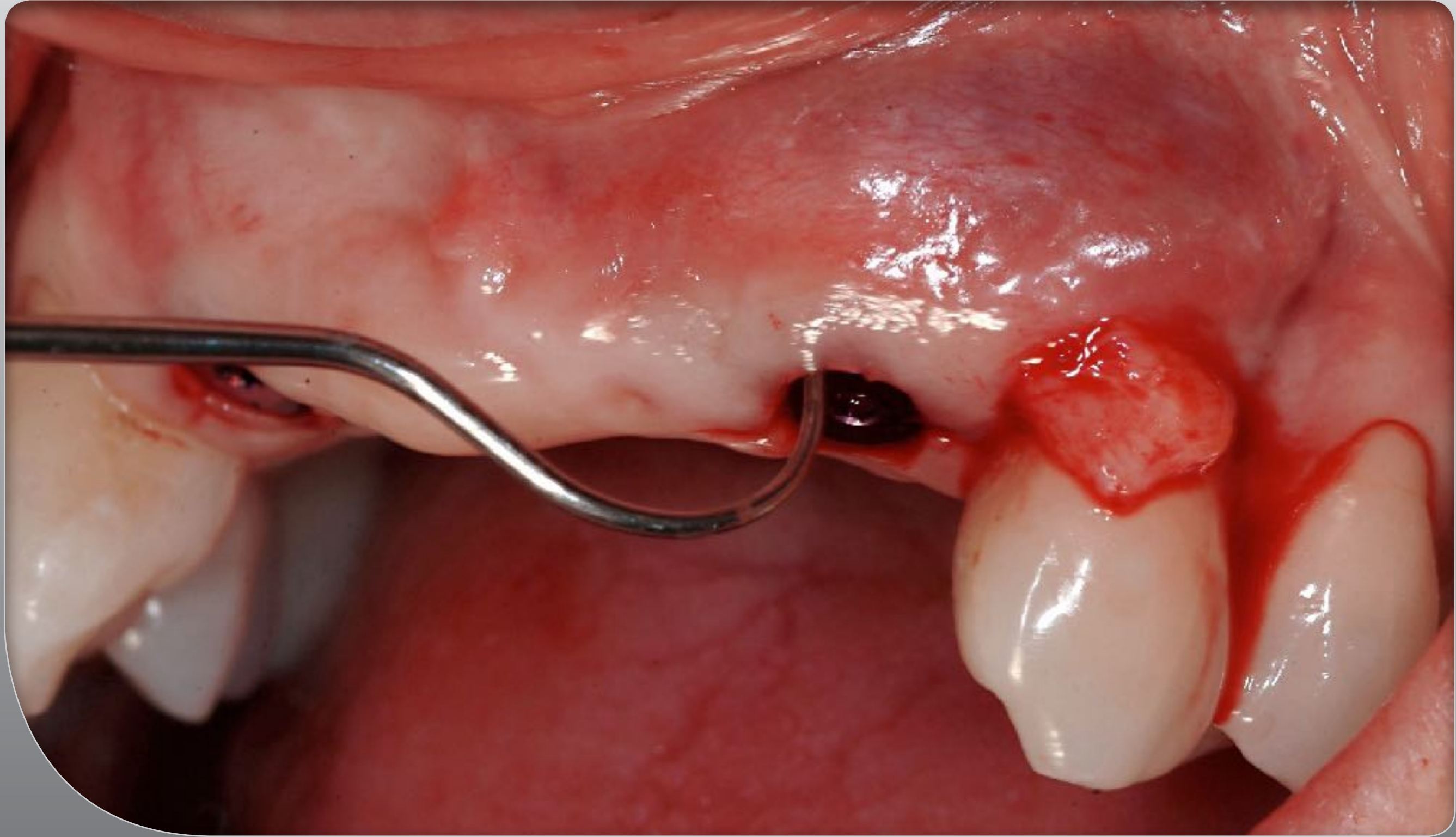


- mesial papilla regeneration @ 3-6 months
- distal papilla regeneration @ 6-12 months
- 10% of distal papilla deteriorated

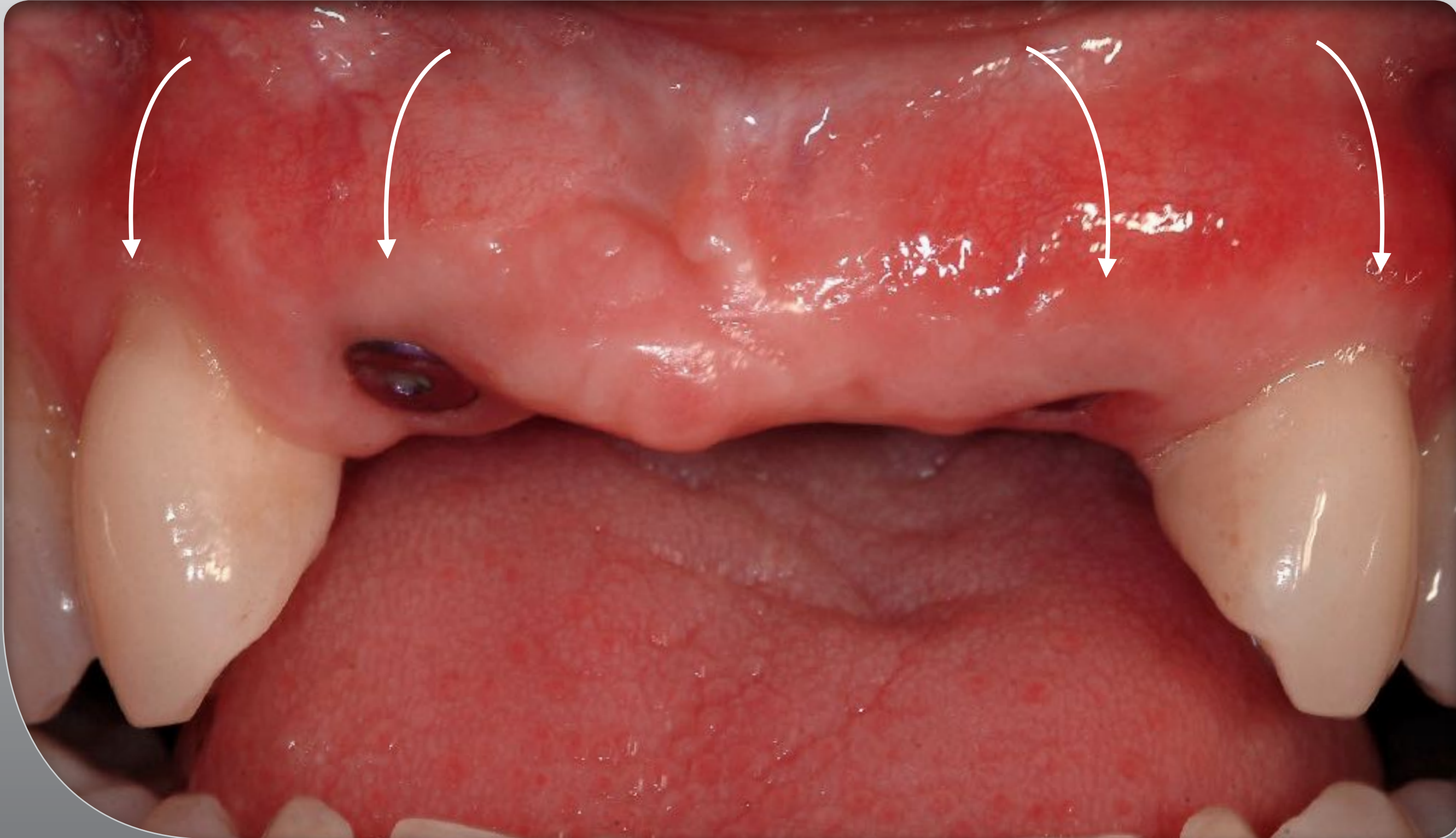
Cosyn J, BeBruyn H, Cleymaet R. Soft tissue preservation and pink aesthetics around single immediate implant restorations: a 1-year prospective study. Clin Implant Dent Relat Res 2013;15:847-857.



narrow connective tissue graft
enhancing implant/tooth mucosal thickness & width
root coverage



CTG @ implant placement

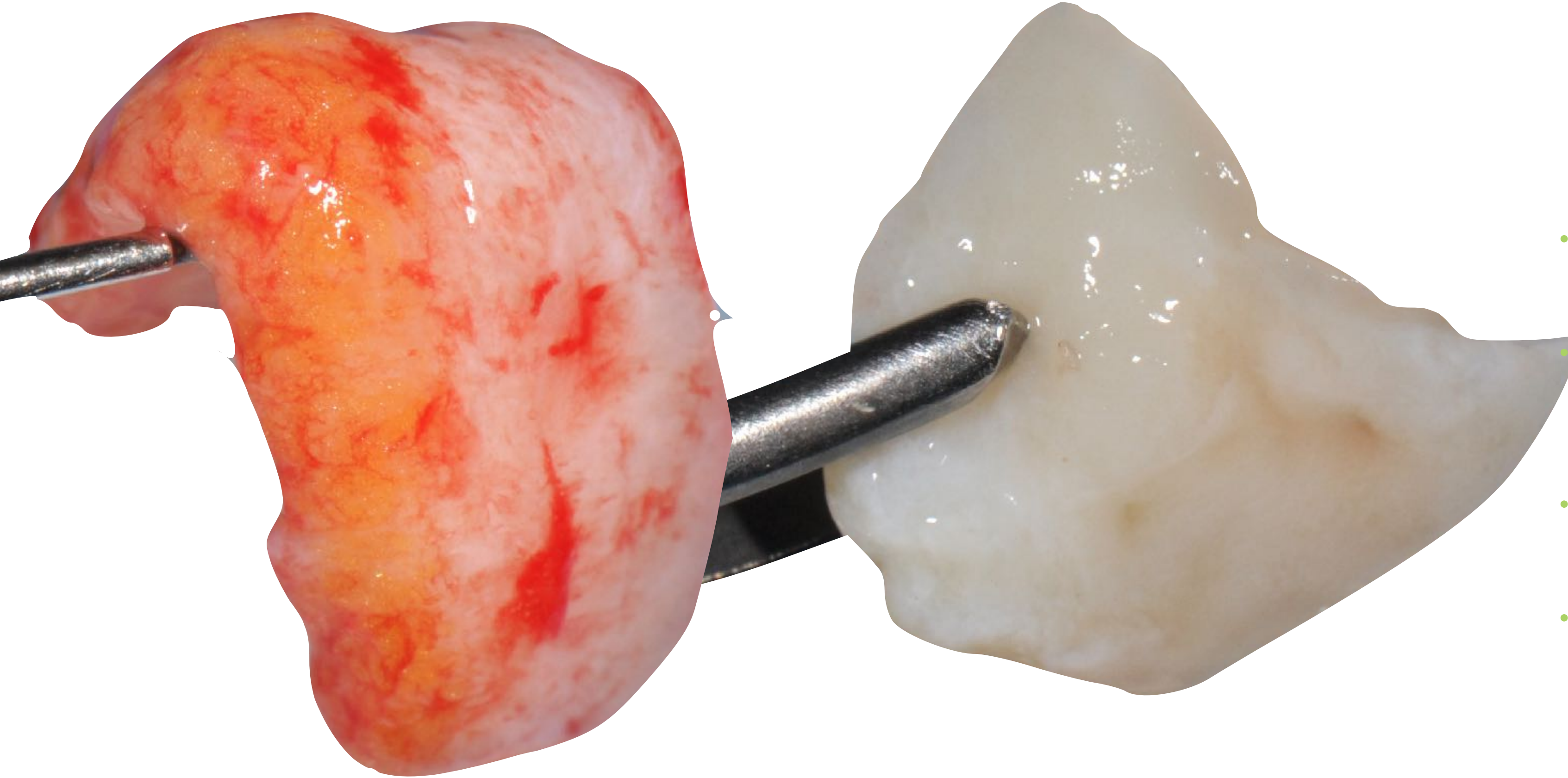


CTG @ 3 months integration





KEY ...graft quality . harvesting methods

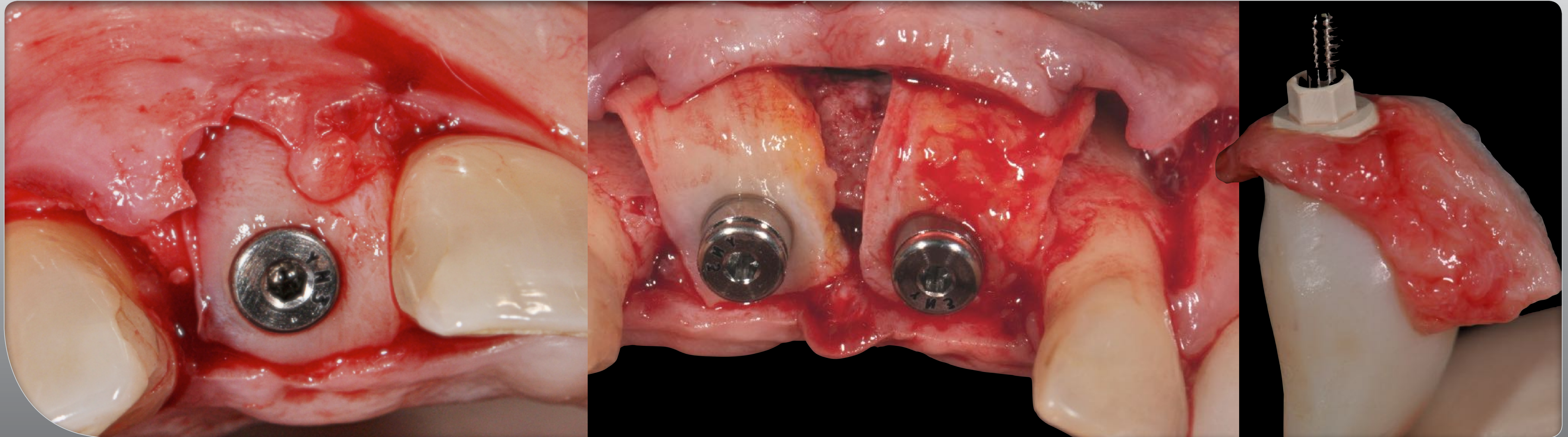


connective tissue graft
> submucosa

tuberosity graft
> lamina propria

- Suarez-Lopez F et al. Influence of soft tissue thickness of peri-implant marginal bone loss: A systematic review and meta-analysis. *J Perio* 2016;87(6): 690-699.
- Bertl K, Pifl M, Hirtler L et al. Relative composition of fibrous connective and fatty/glandular tissue in connective tissue grafts depends on the harvesting technique but not the donor site of the hard palate. *J Periodontol.* 2015;86(12):1331-1339.
- Heil A, Schwindling FS, Jelinek C et al. Determination of the palatal masticatory mucosa thickness by dental MRI: a prospective study analyzing age and gender effects. *Dentomaxillofac Radiol* 2017.
- Tavelli L, Barootchi S, Greenwell H, Wang HL. Is a soft tissue graft harvested from the maxillary tuberosity the approach of choice in an isolated site? *J Periodontol.* 2019;90:821-825.

some evidence that supracrestal tissue height (**short <2mm**) \uparrow physiologic marginal bone loss
augmentation can \downarrow crestal bone loss



'sticky bone' residual horizontal bone defect
facial contour augmentation



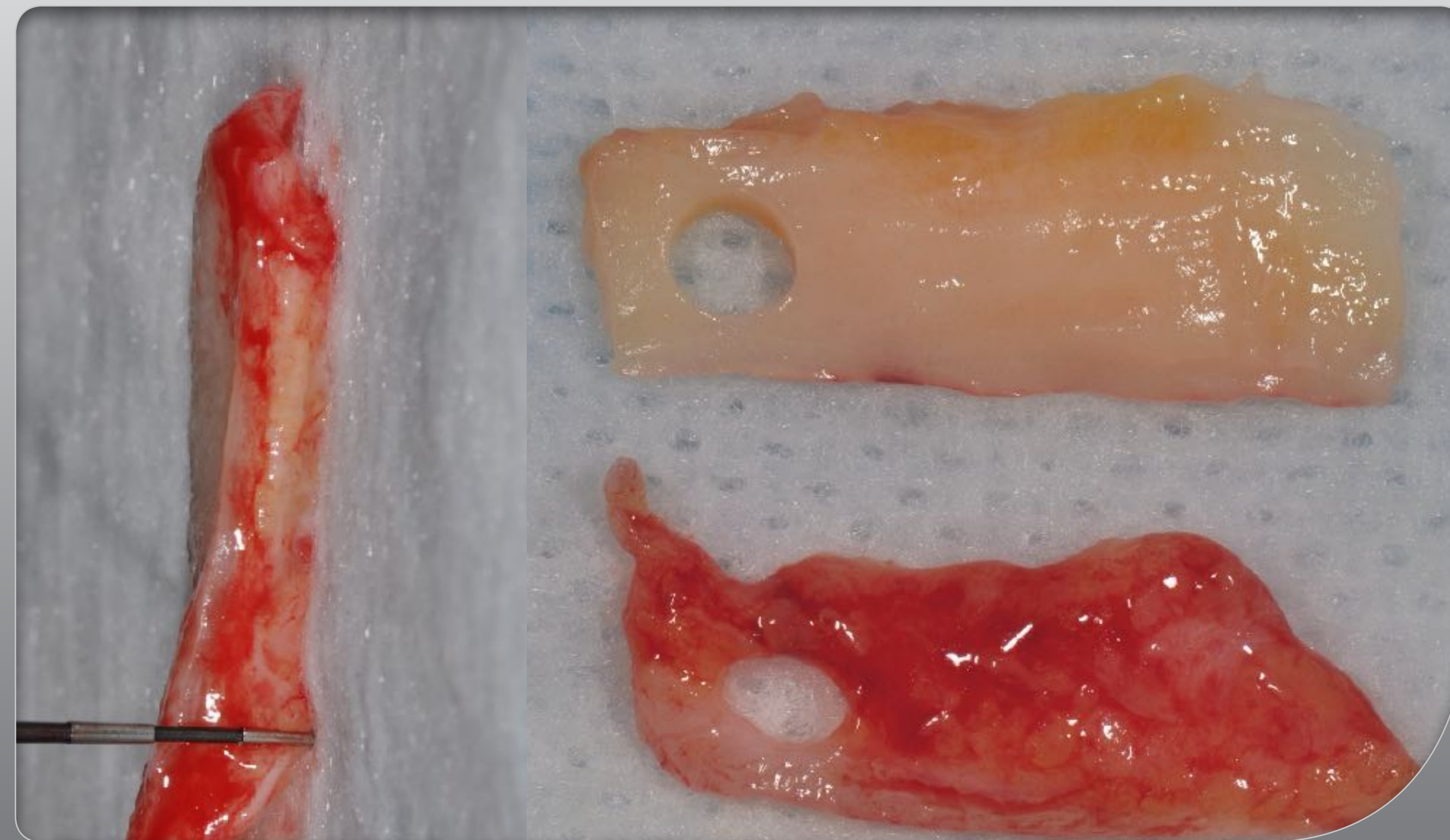
CT graft
coronally advance margin & enhance phenotype



Bertl K, Pifl M, Hirtler L et al. Relative composition of fibrous connective and fatty/glandular tissue in connective tissue grafts depends on the harvesting technique but not the donor site of the hard palate. J Periodontol. 2015;86(12):1331-1339.

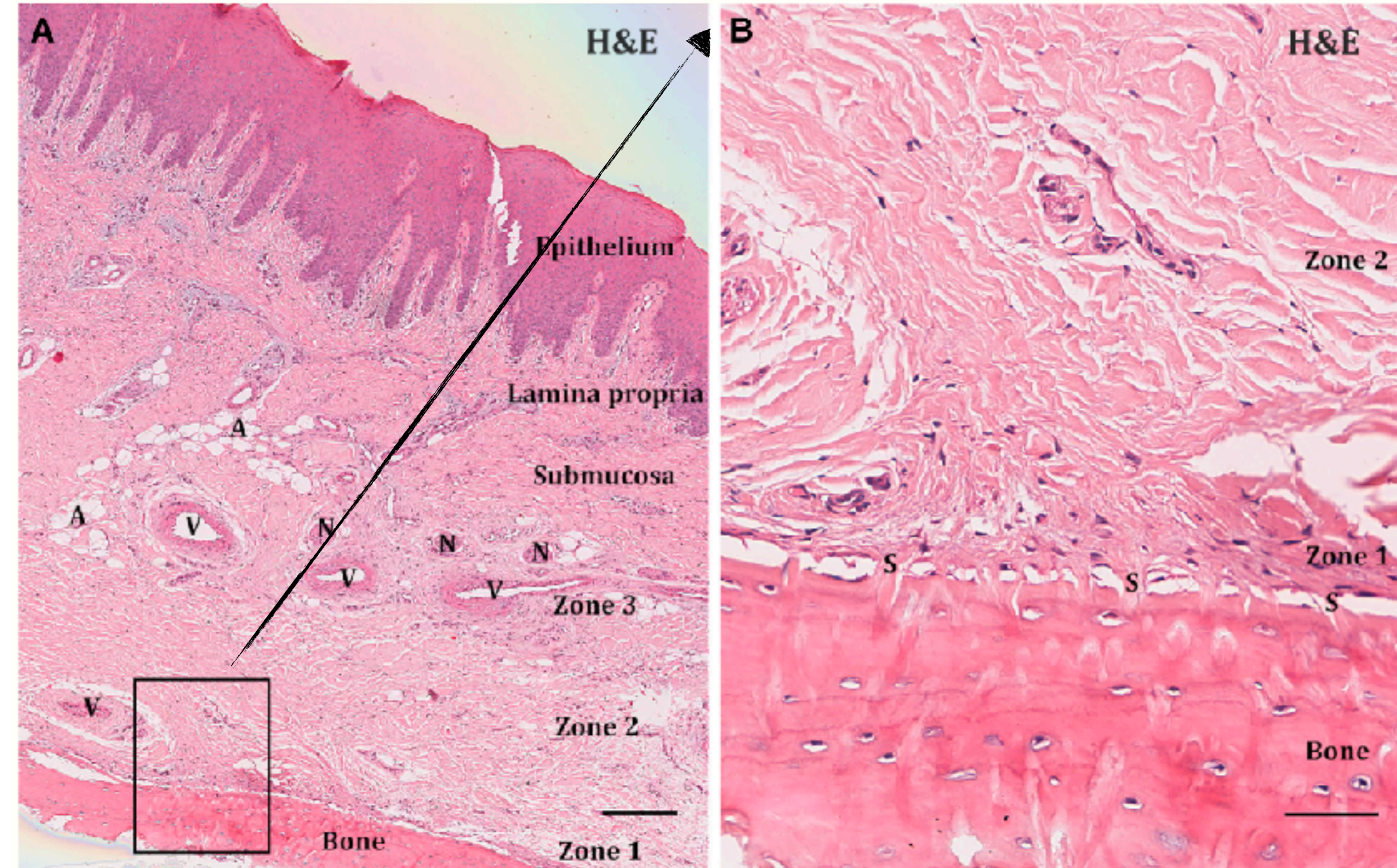
Heil A, Schwindling FS, Jelinek C et al. Determination of the palatal masticatory mucosa thickness by dental MRI: a prospective study analyzing age and gender effects. Dentomaxillofac Radiol 2017.

- palate mucosa thickness range: 2.35 - 6.89mm
 - thickness increased with age (30-39 to 40-49).
 - insignificant gender impact
 - molars lowest average thickness vs. premolars/canines
- anteroposterior composition differences
- high variability in composition (% CT, fat/glandular tissue)
 - thick palates - higher % FGT, thinner lamina propria
- tissue quality dependent on harvesting technique.
 - superficial ... more fibrous
 - deeper ... fatty/glandular





Palatal histology: From Tavelli et al. J Oral Maxillofac Surg 2019.
 A= adipose cells, V= vessels, N= nerve bundles



Epithelium

- orthokeratinized, approx 0.36mm thick.
- thickest at canines VS. premolars/molars

Lamina propria

- dense bilayered CT. Type I/III collagen
- superior papillary layer locks epithelium
- deeper thick/dense reticular fibers

Submucosa

- large concentration of glandular & adipose tissue
- may not be present at midline and anterior palate

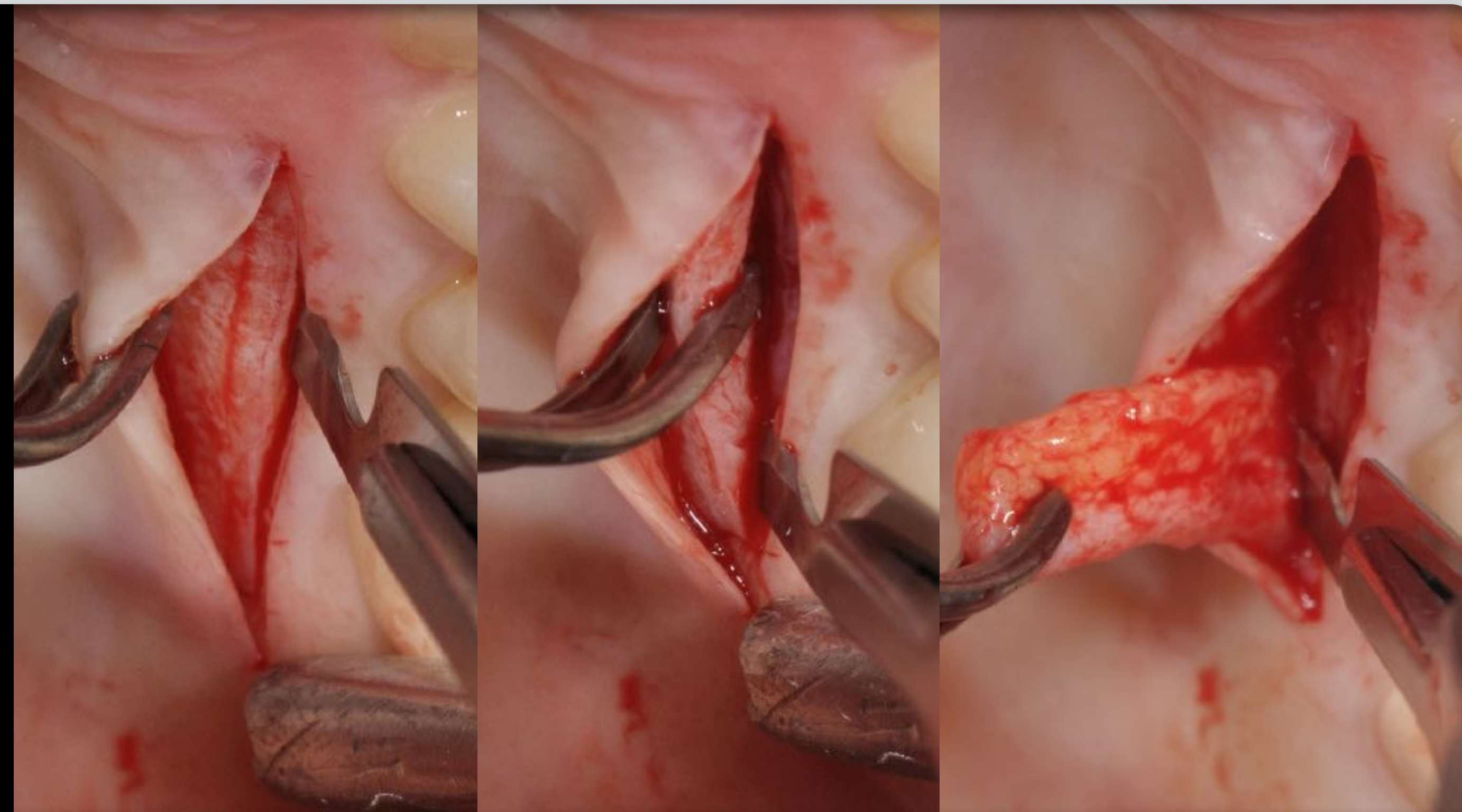
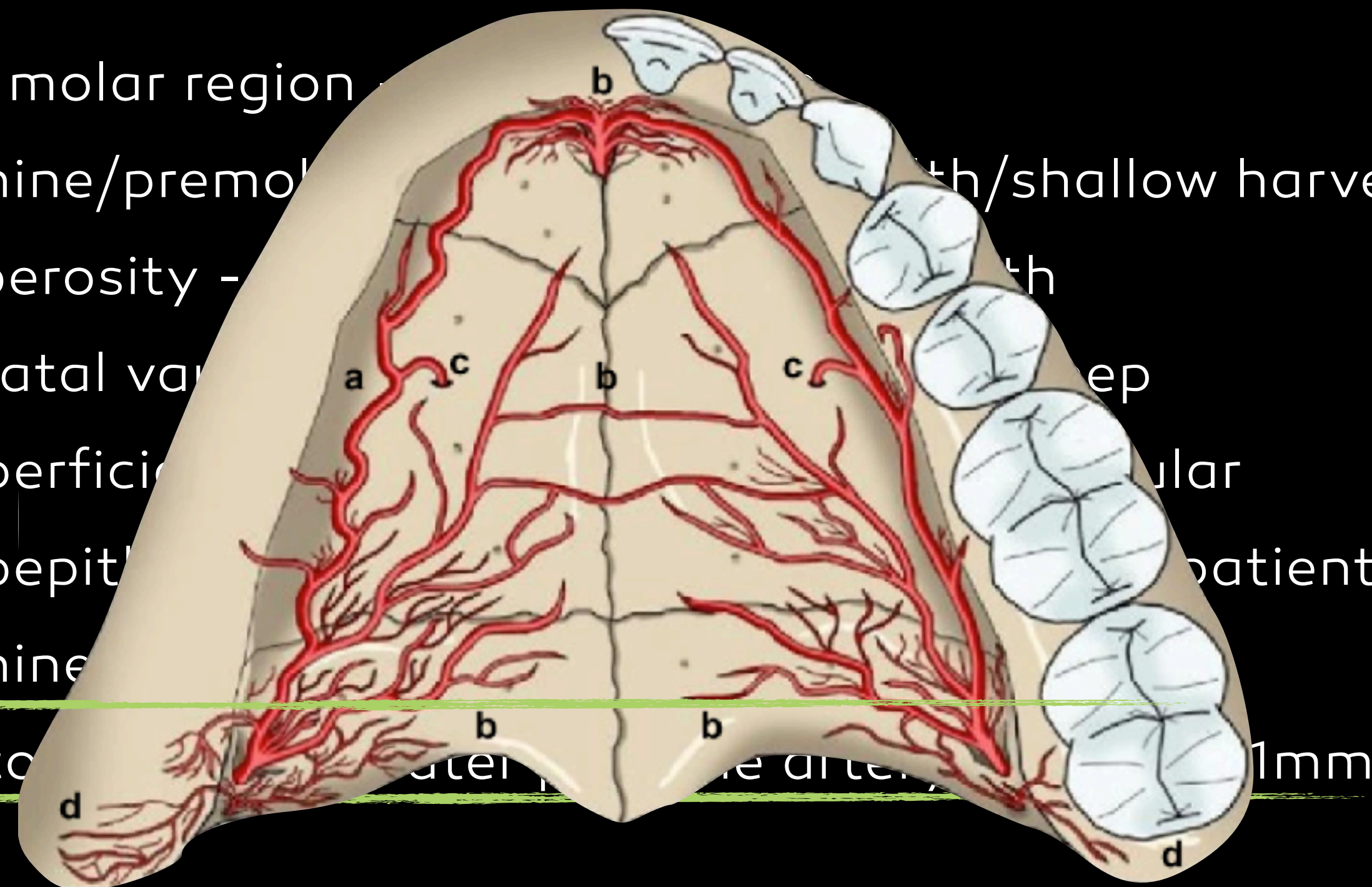
Periosteum

- 3 zones
 - innermost- osteogenic layer attached to bone
 - mid- highly vascularized, fibroblasts & progenitor cells
 - outermost dense collagen fibers

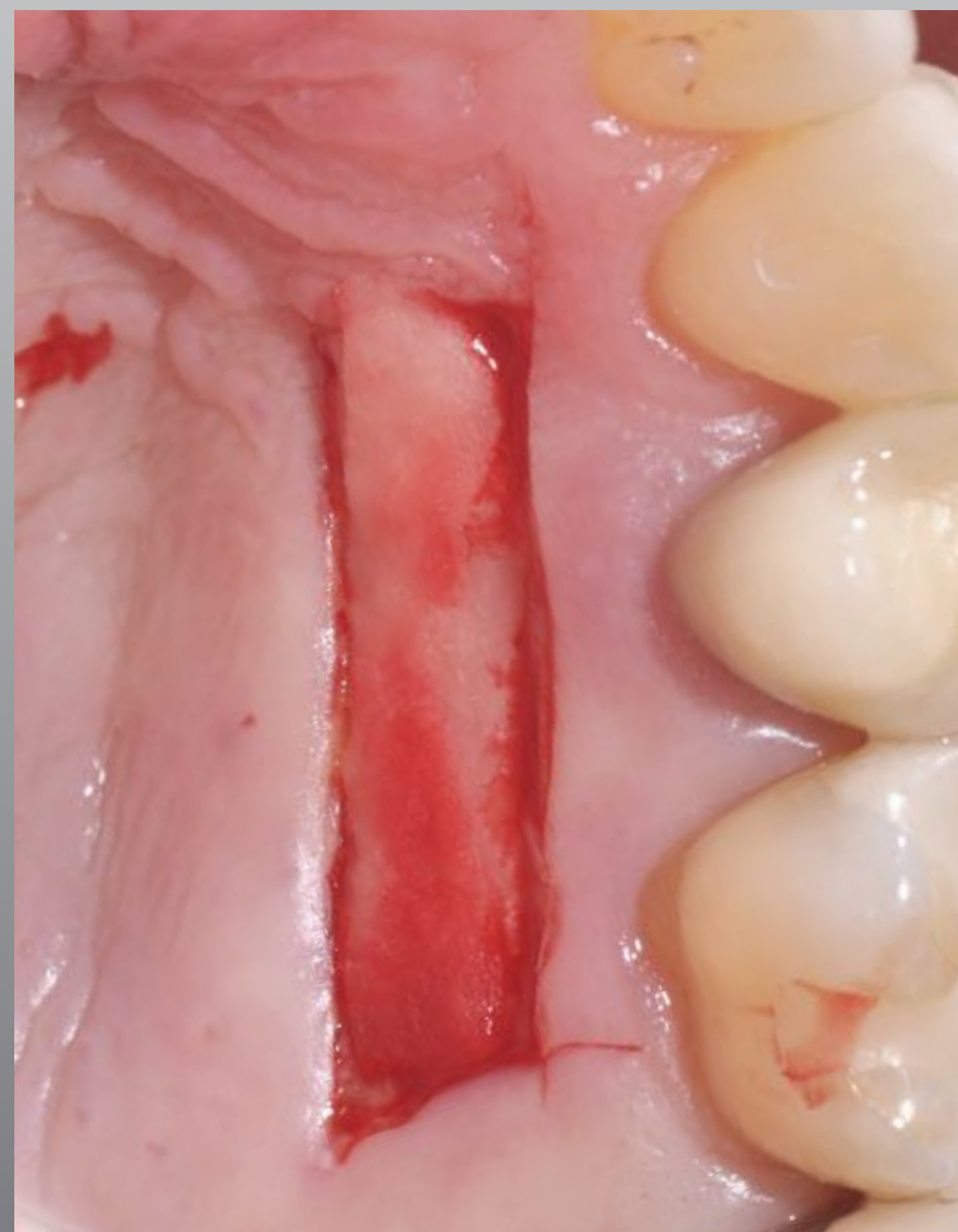
DONOR SITE CONSIDERATIONS

reiser gm, bruno jf et al 1996
 studer sp, allen ep et al 1997
 muller 2000, Tavelli et al 2019

- 1st molar region
- canine/premolar region with shallow harvest
- tuberosity - with
- palatal var - ep
- superficial - ular
- subepit - patients
- canine
- second molar - 1mm



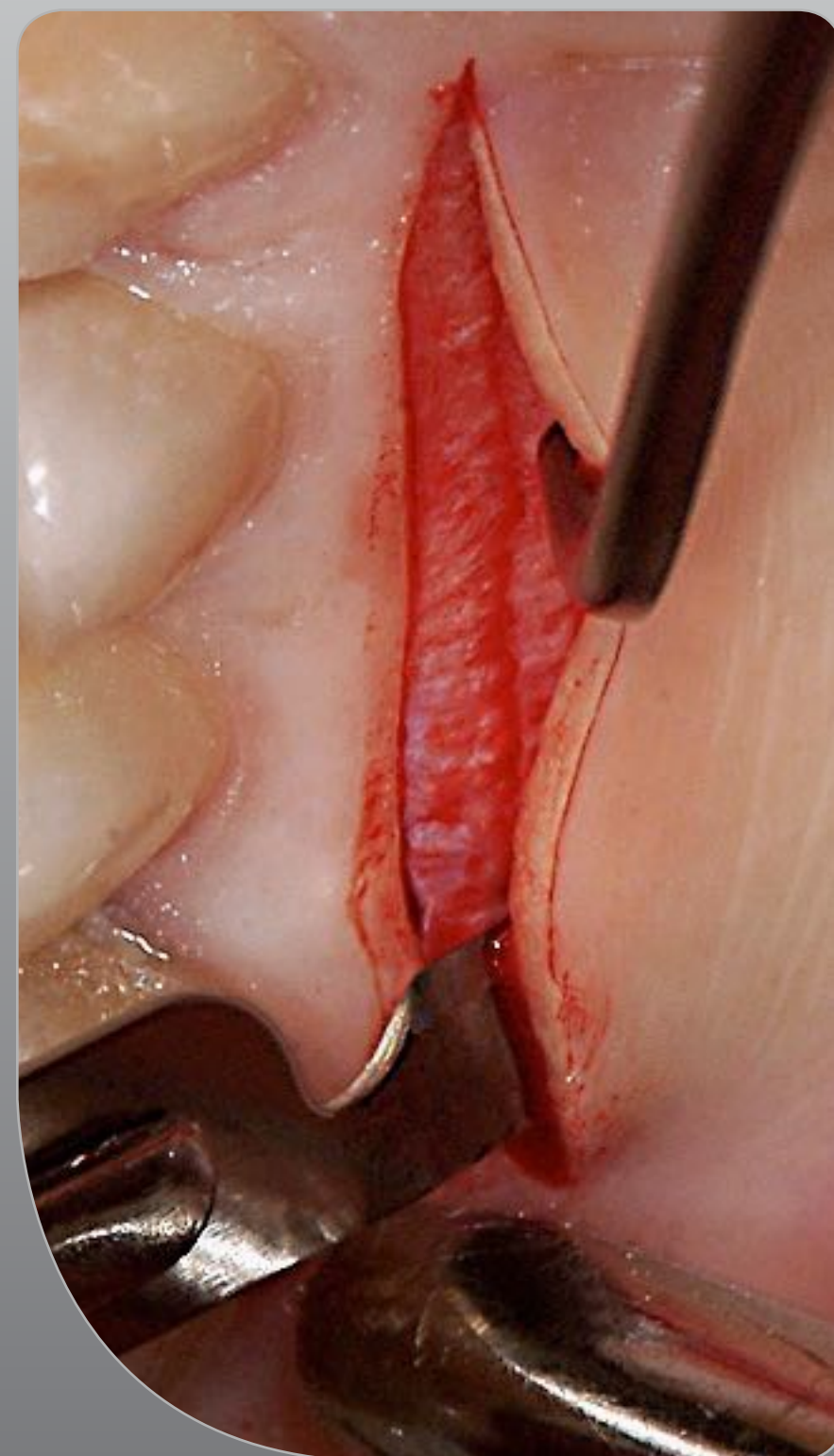
superficial harvest



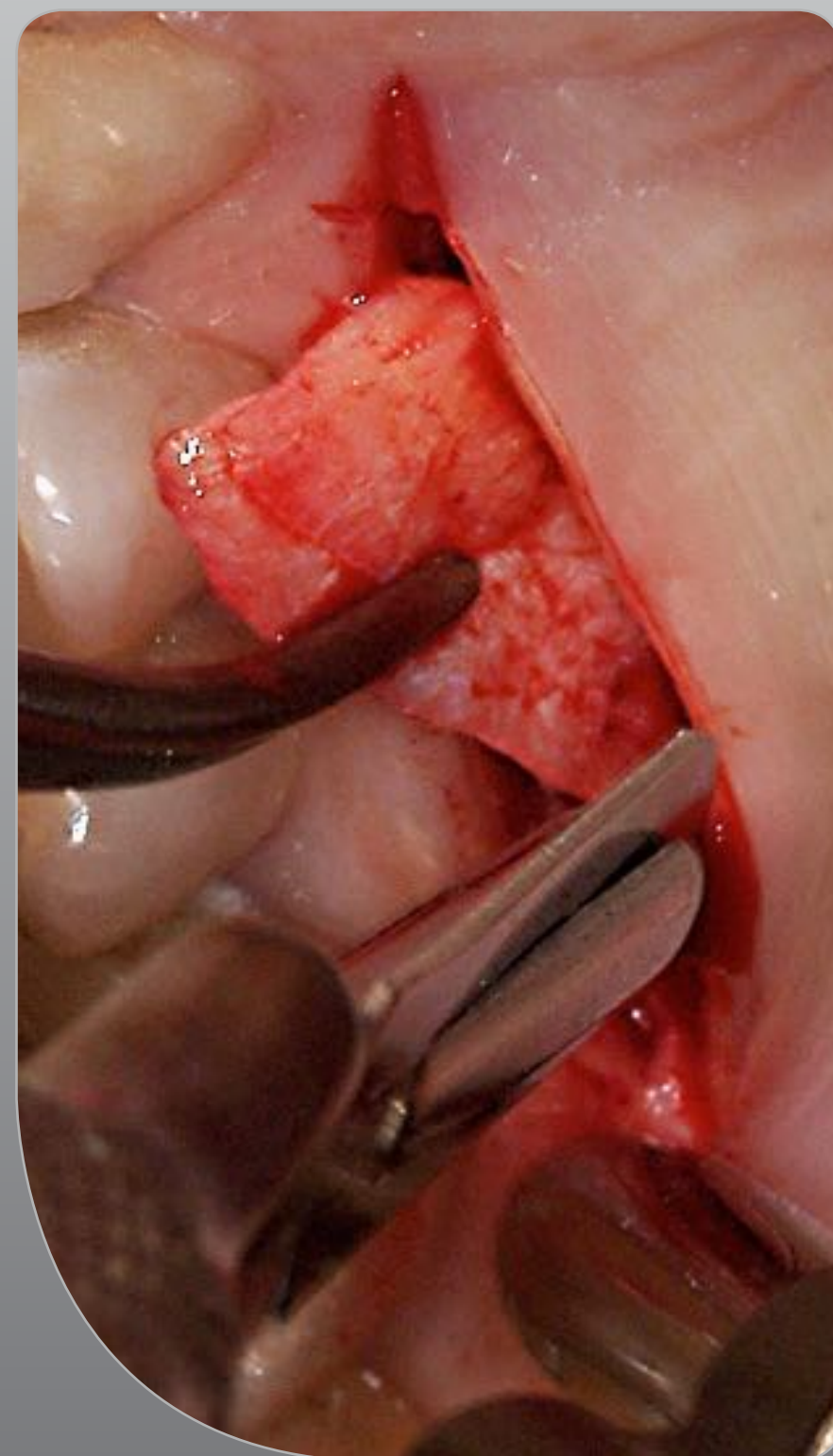
1st incision



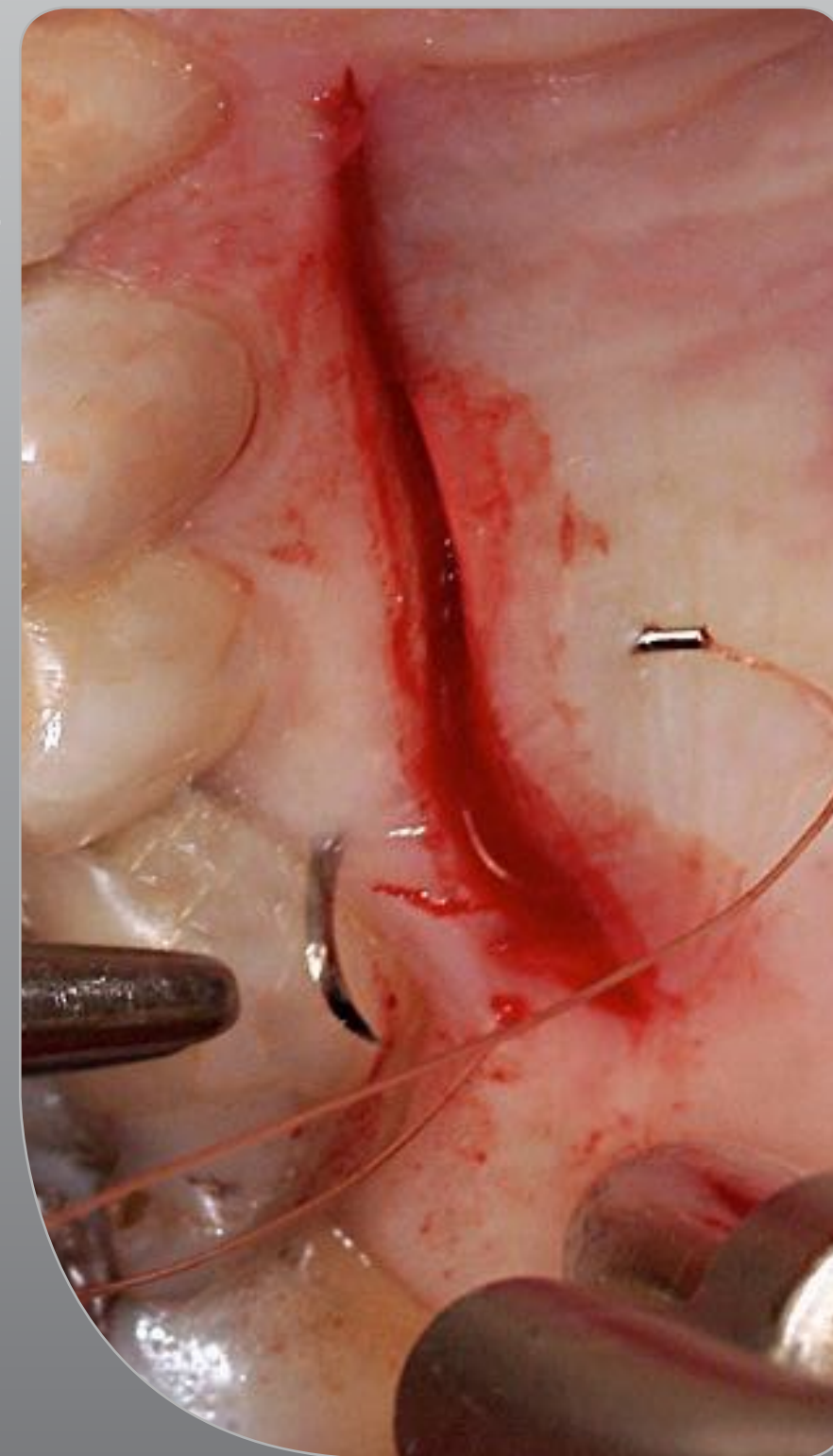
deeper CT



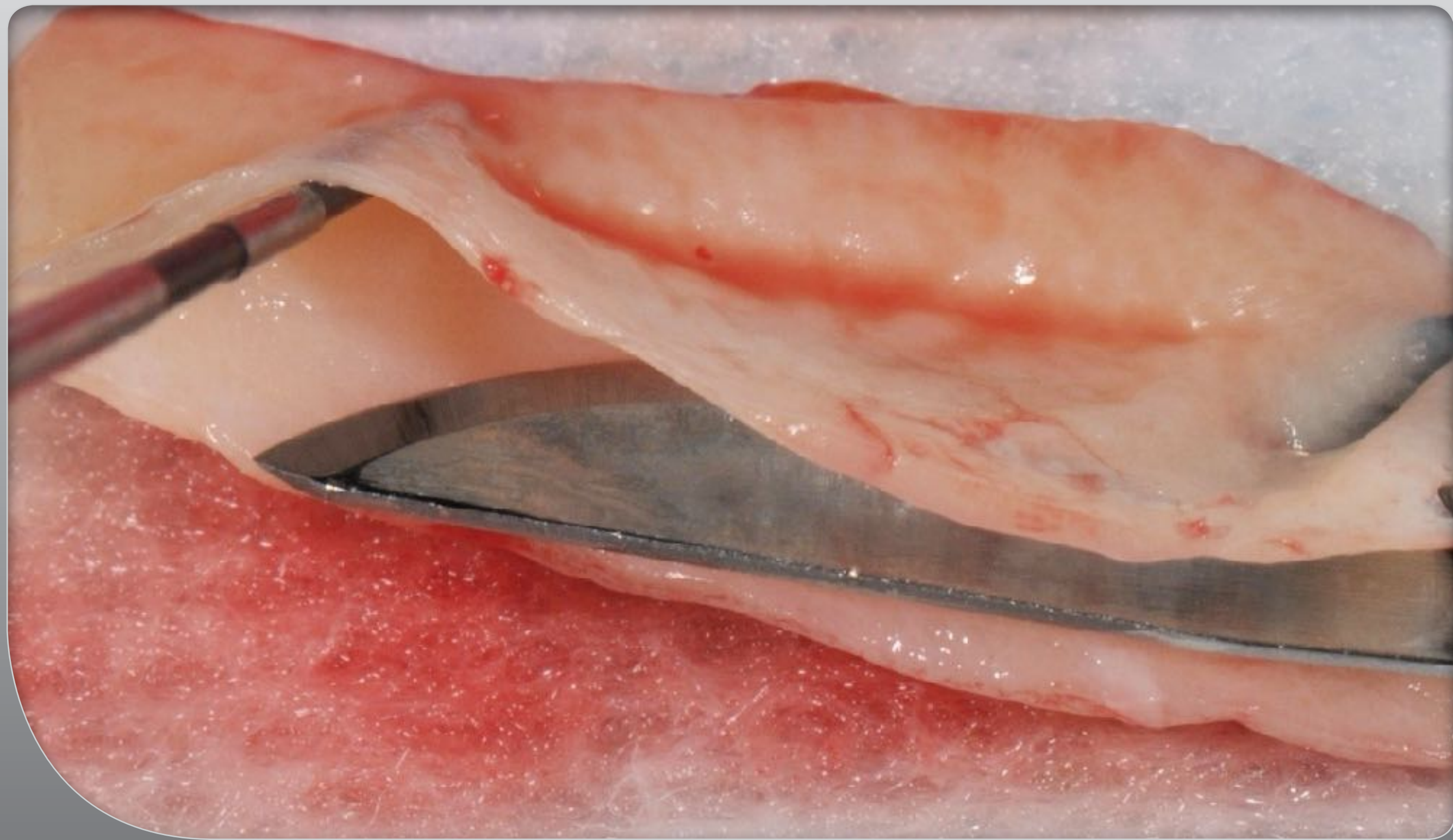
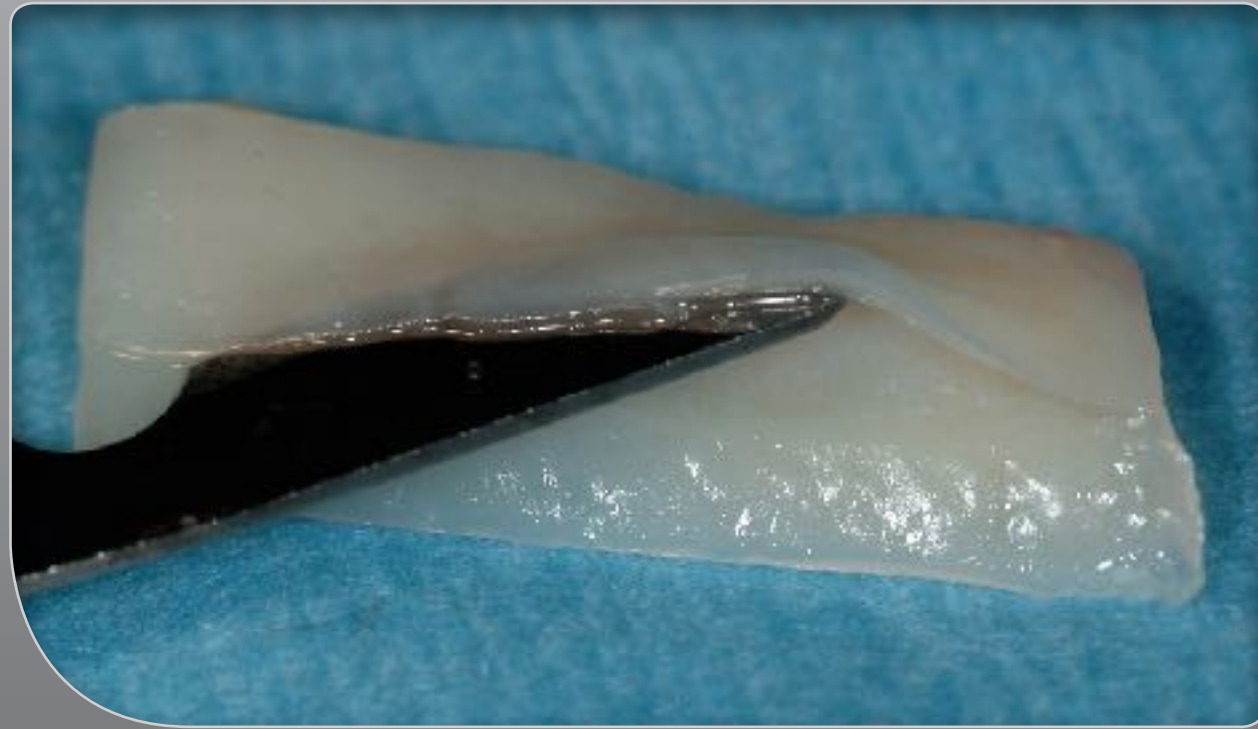
harvest CT

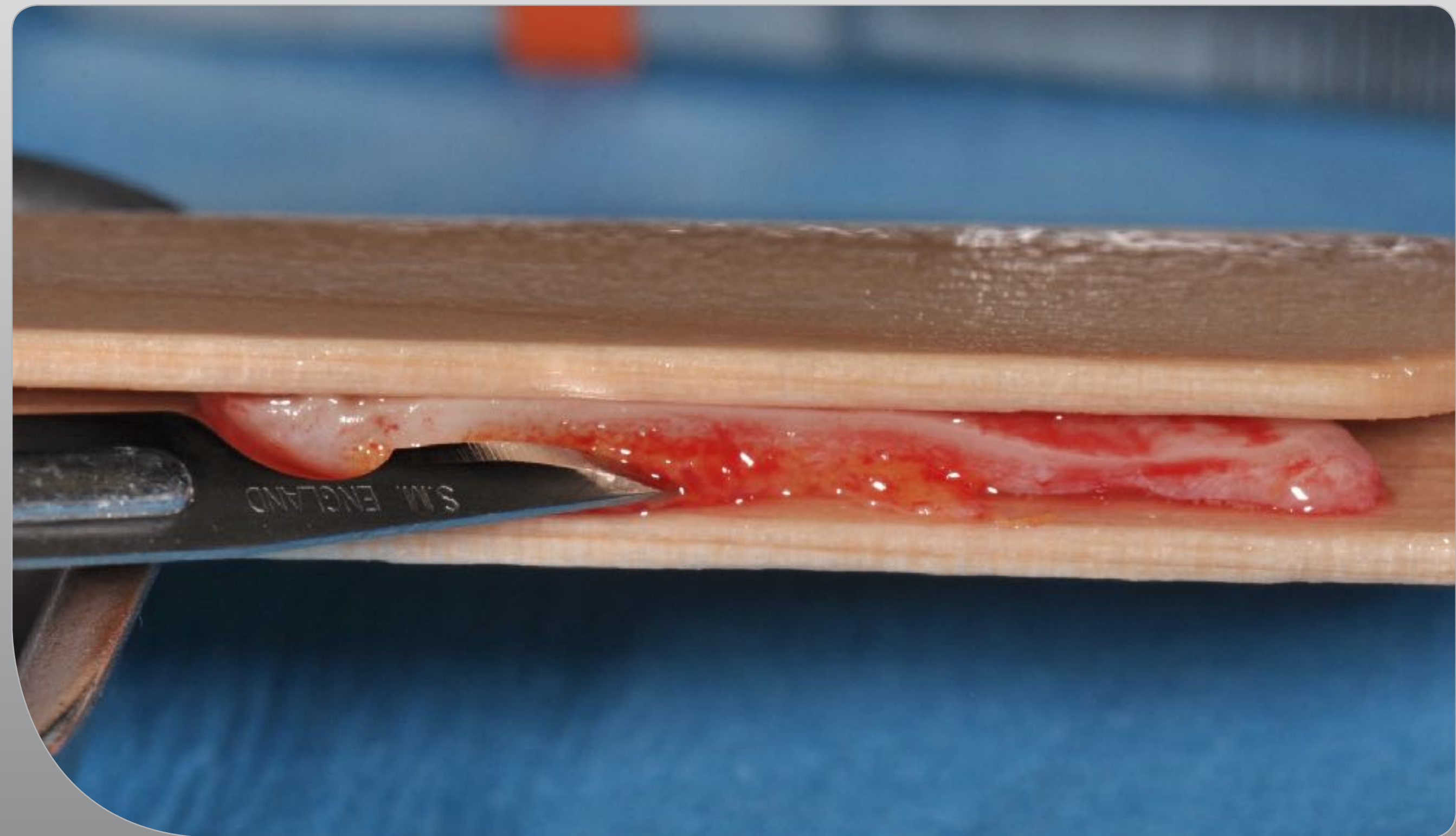
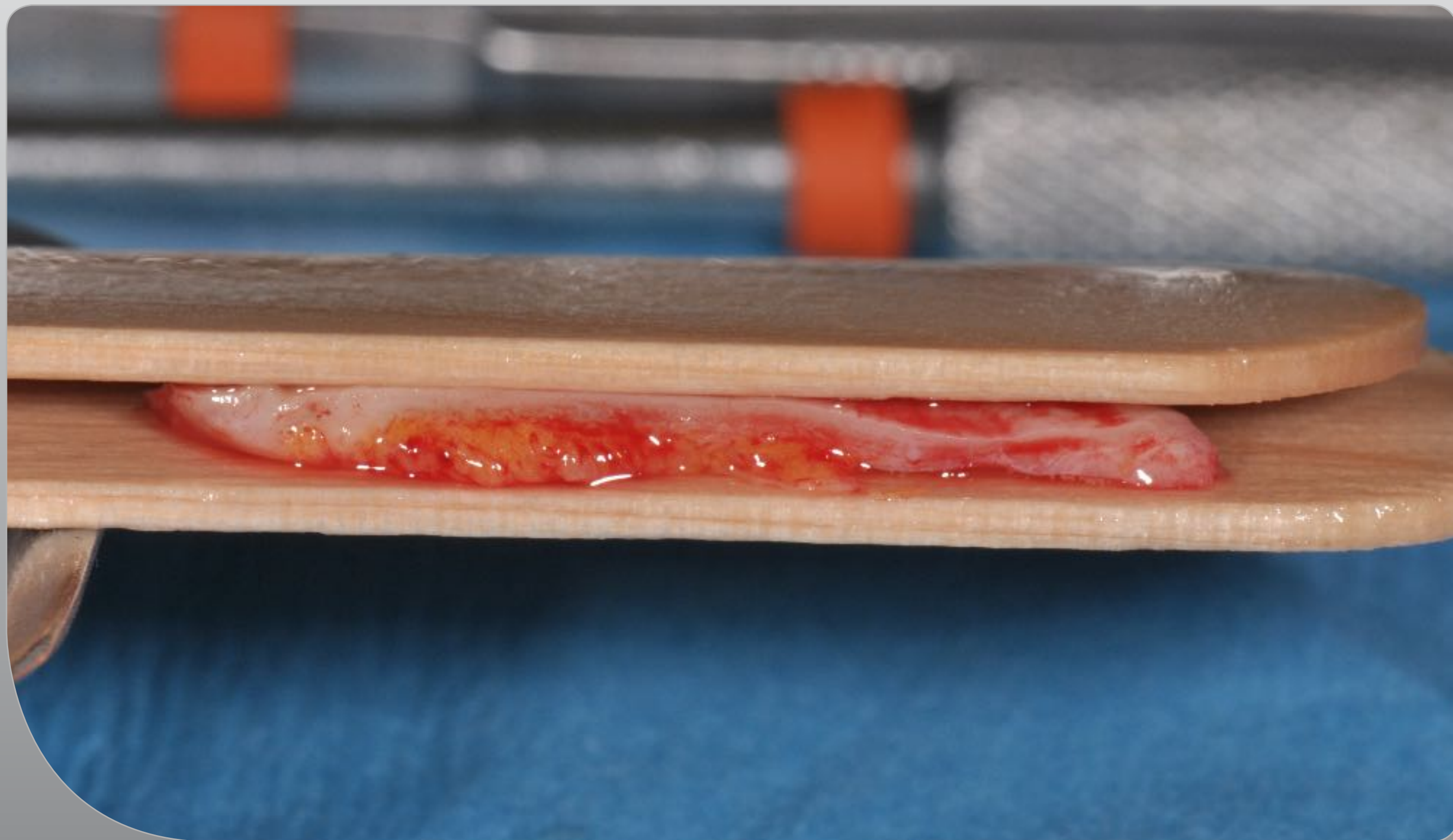


closure

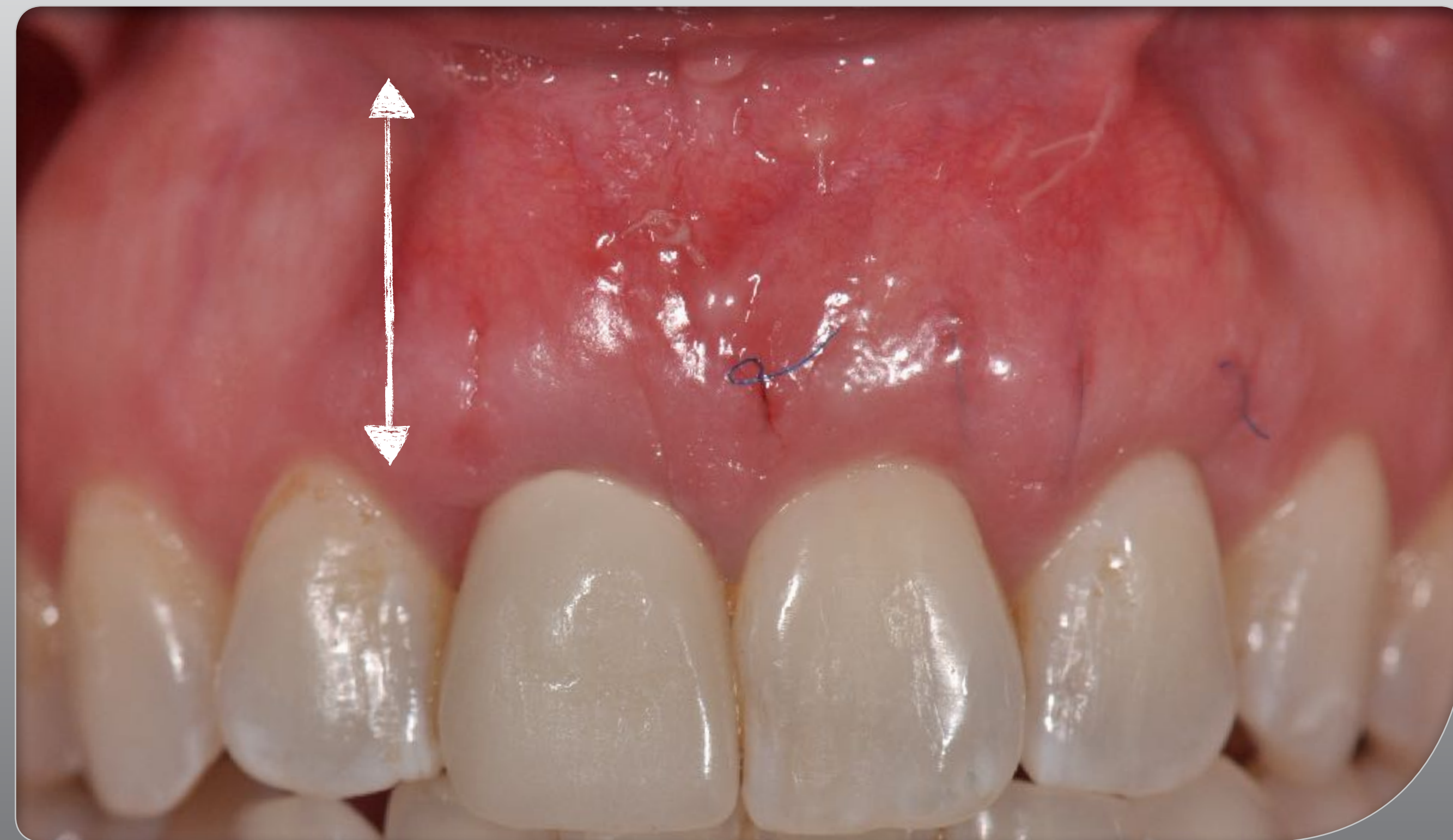


donor site
trap door technique

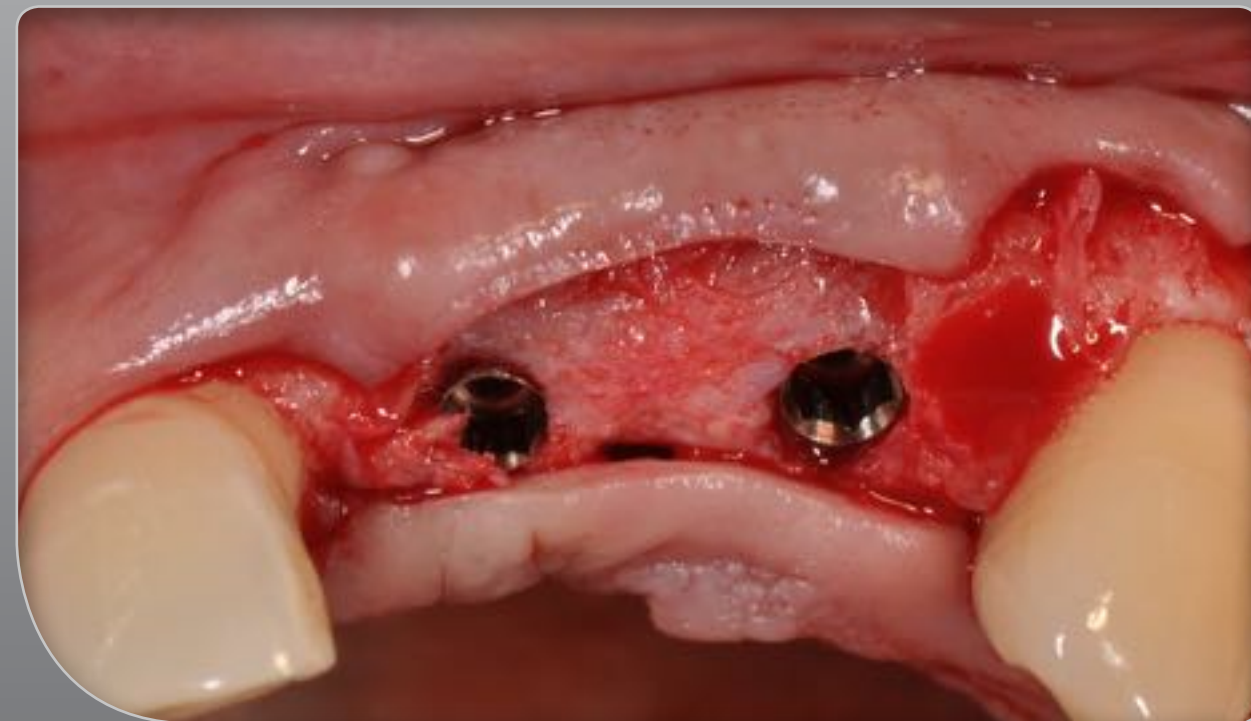
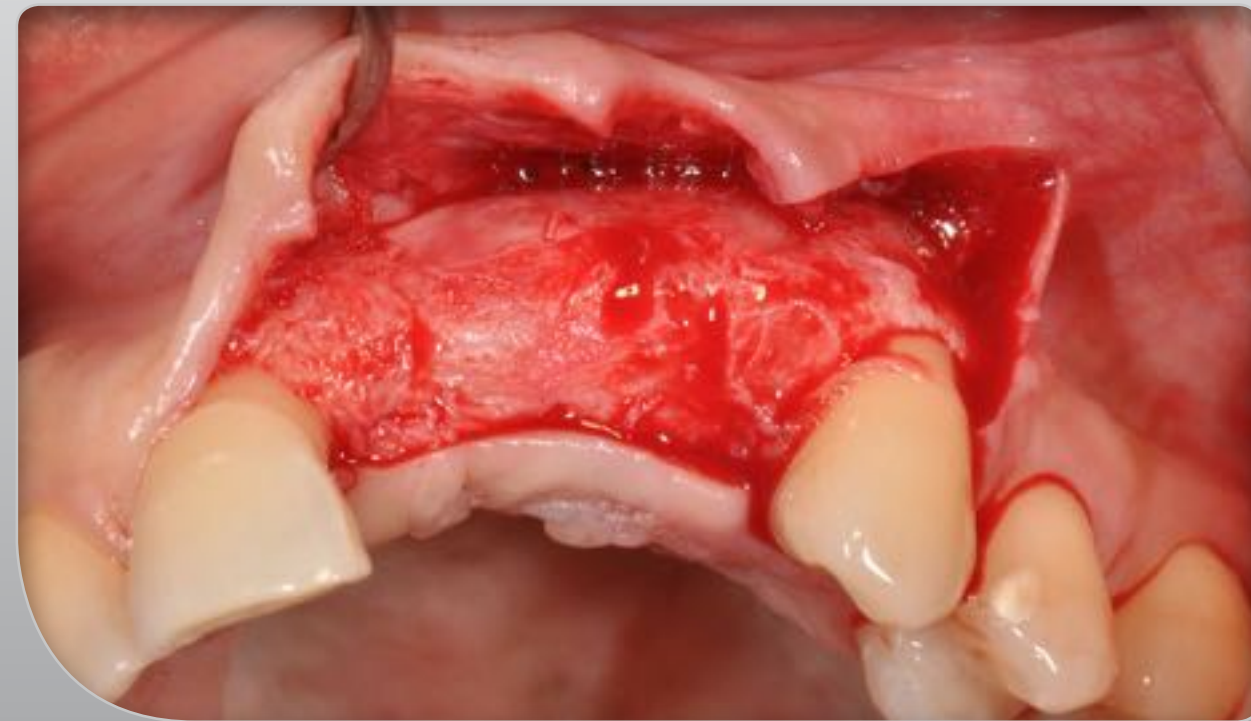
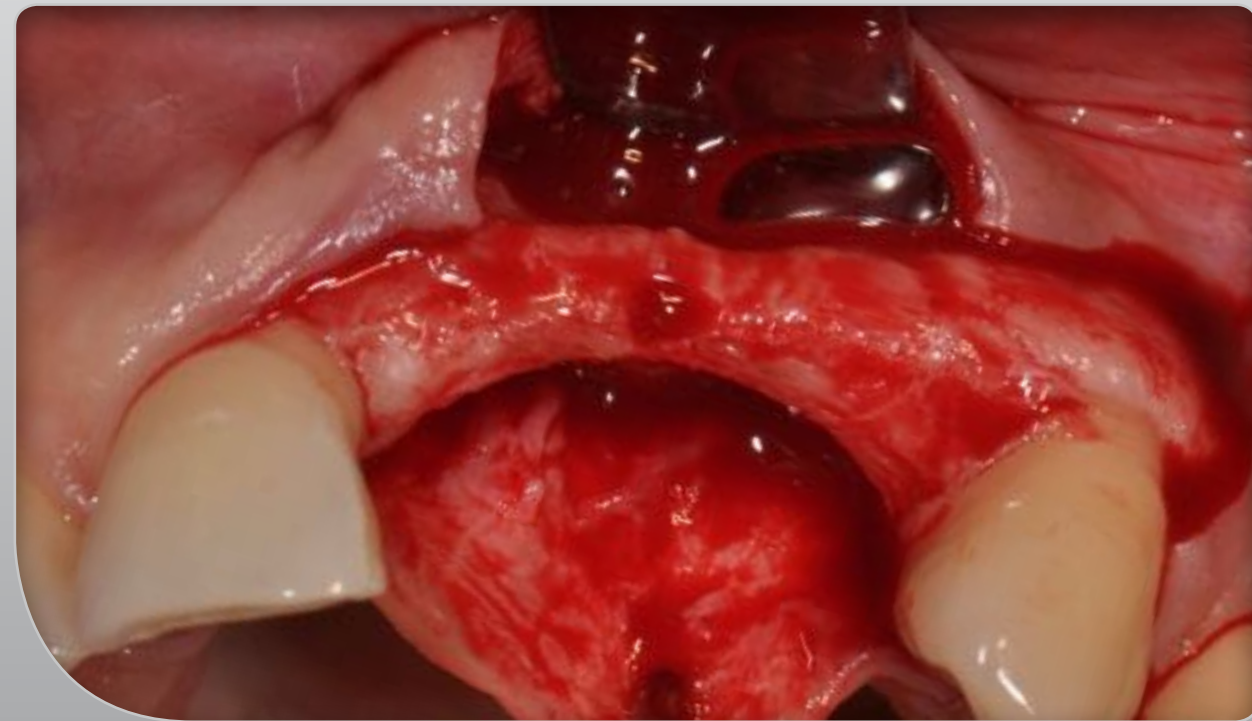




dermal graft height/position
average 12mm +/-
consider vestibular depth

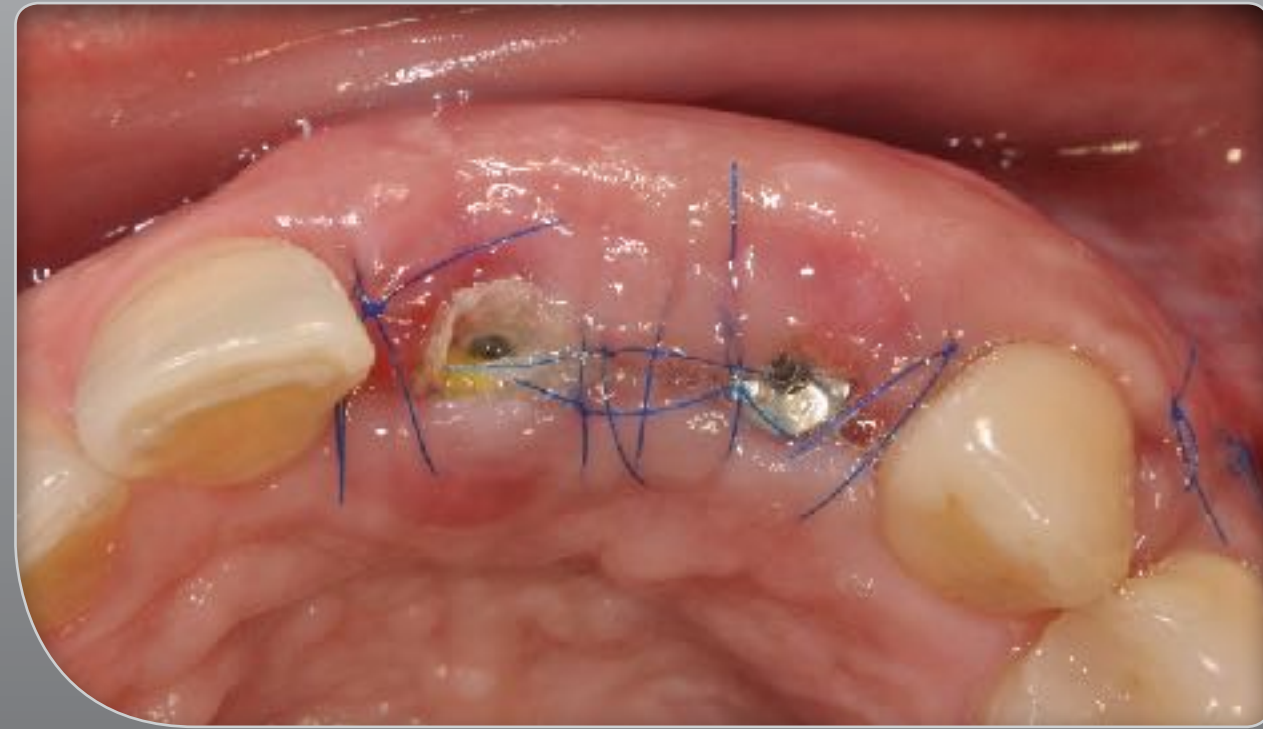
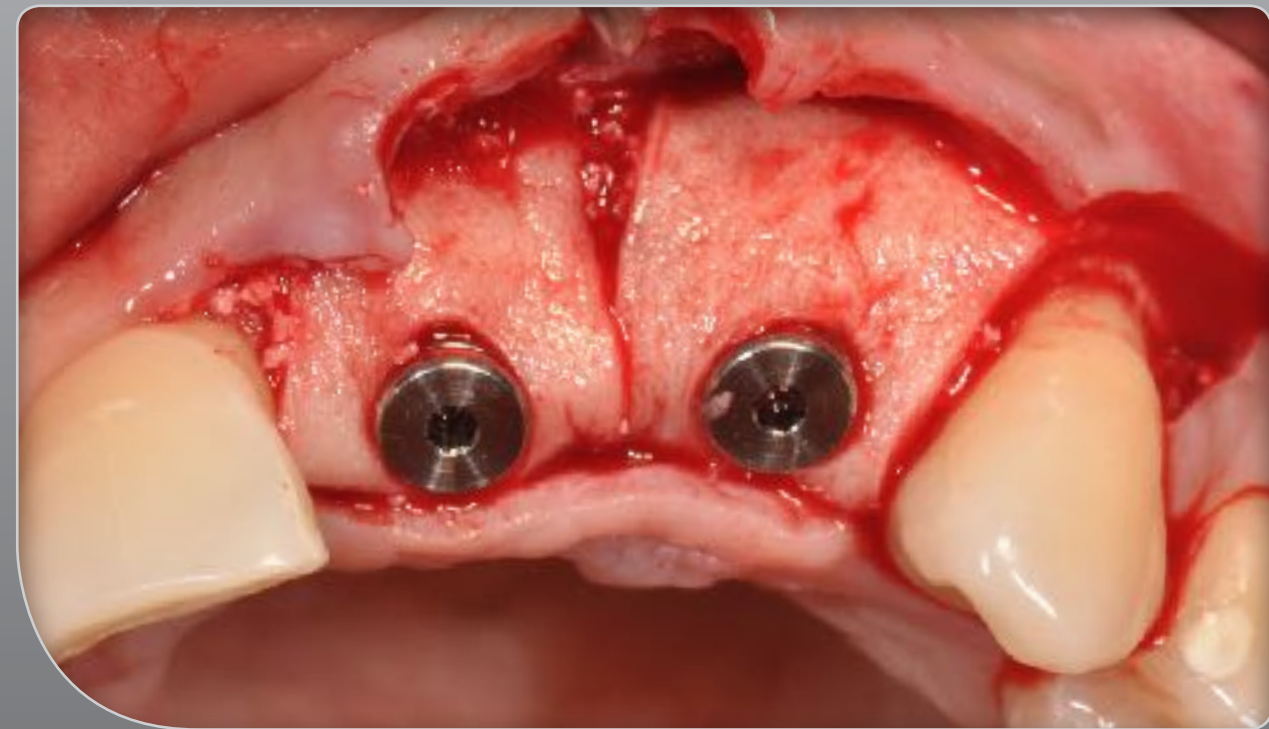


implant/provisional crown



'crude, surgical guide - define placement & anticipate outcomes





Leziy S, Miller B. Papilla between adjacent implants: a critical look at current techniques to optimize esthetic treatment. In Interdisciplinary Treatment Planning. Volume II. Quintessence Publishing 2011.



pink ceramic wings/flossing groove between 9 [21] & 10 [22]







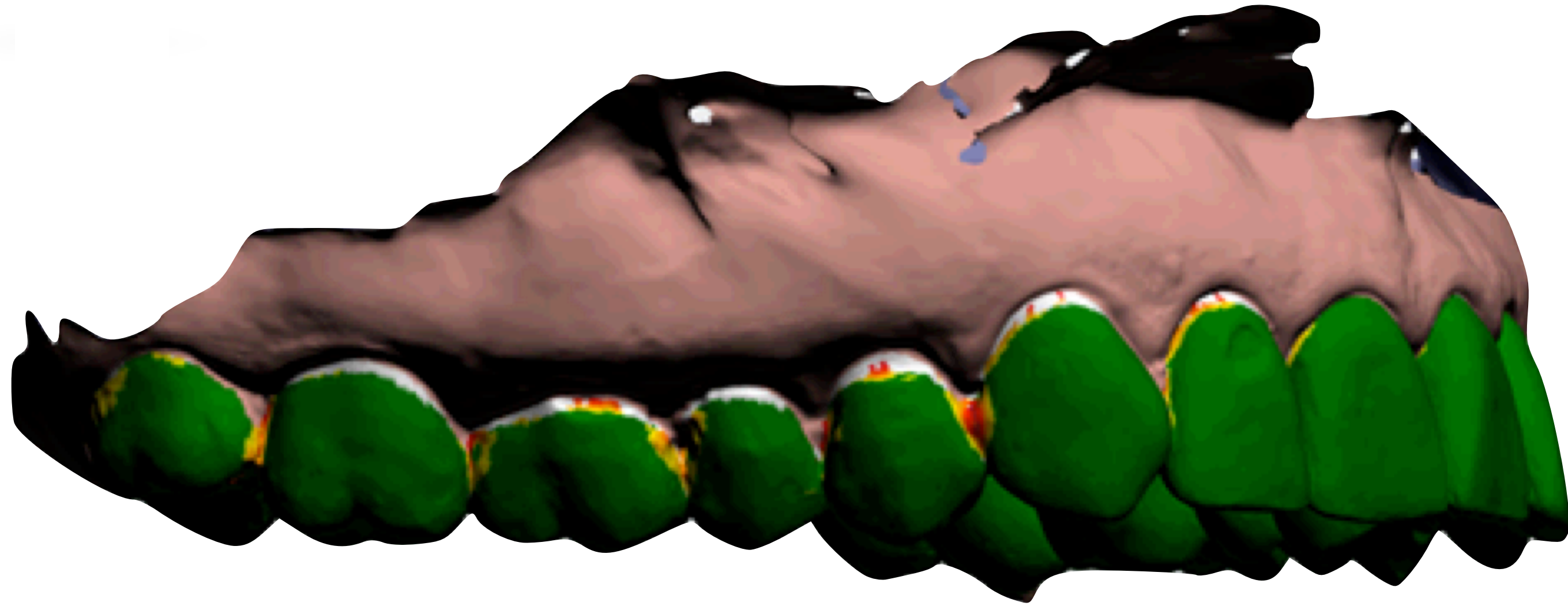






Technology
optical scans to address 'subjective' measurements

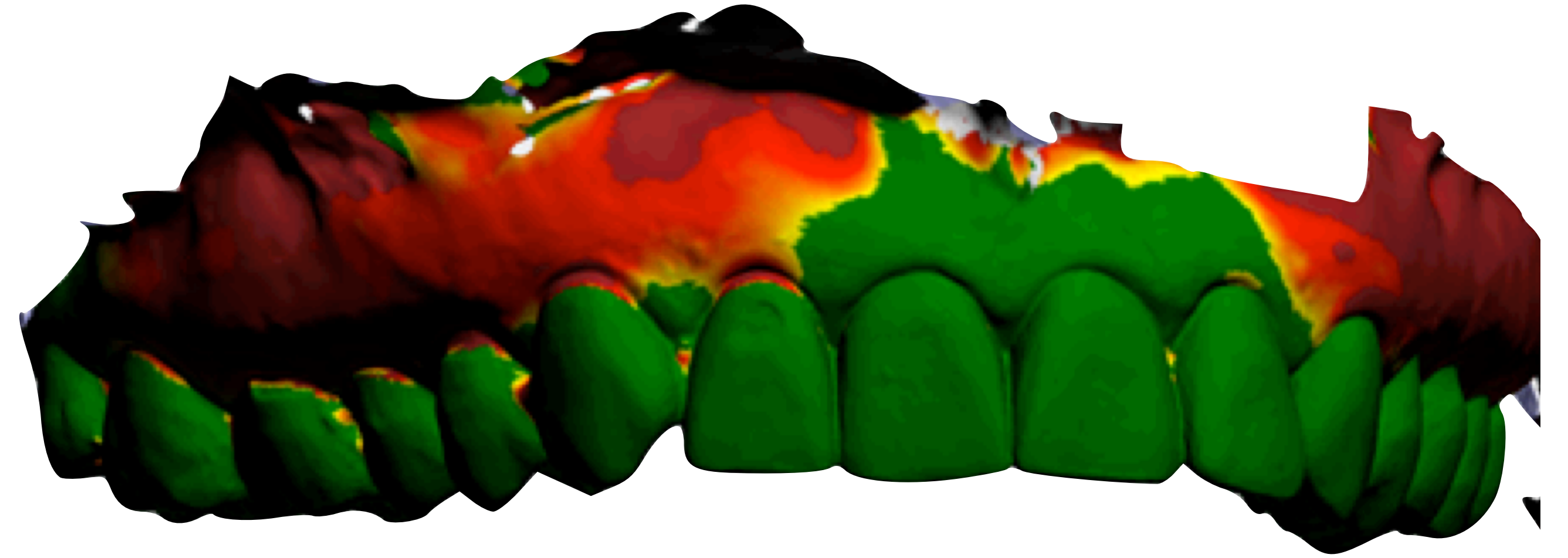




superimposition of scans

time points 1 and 2 (1 year apart)

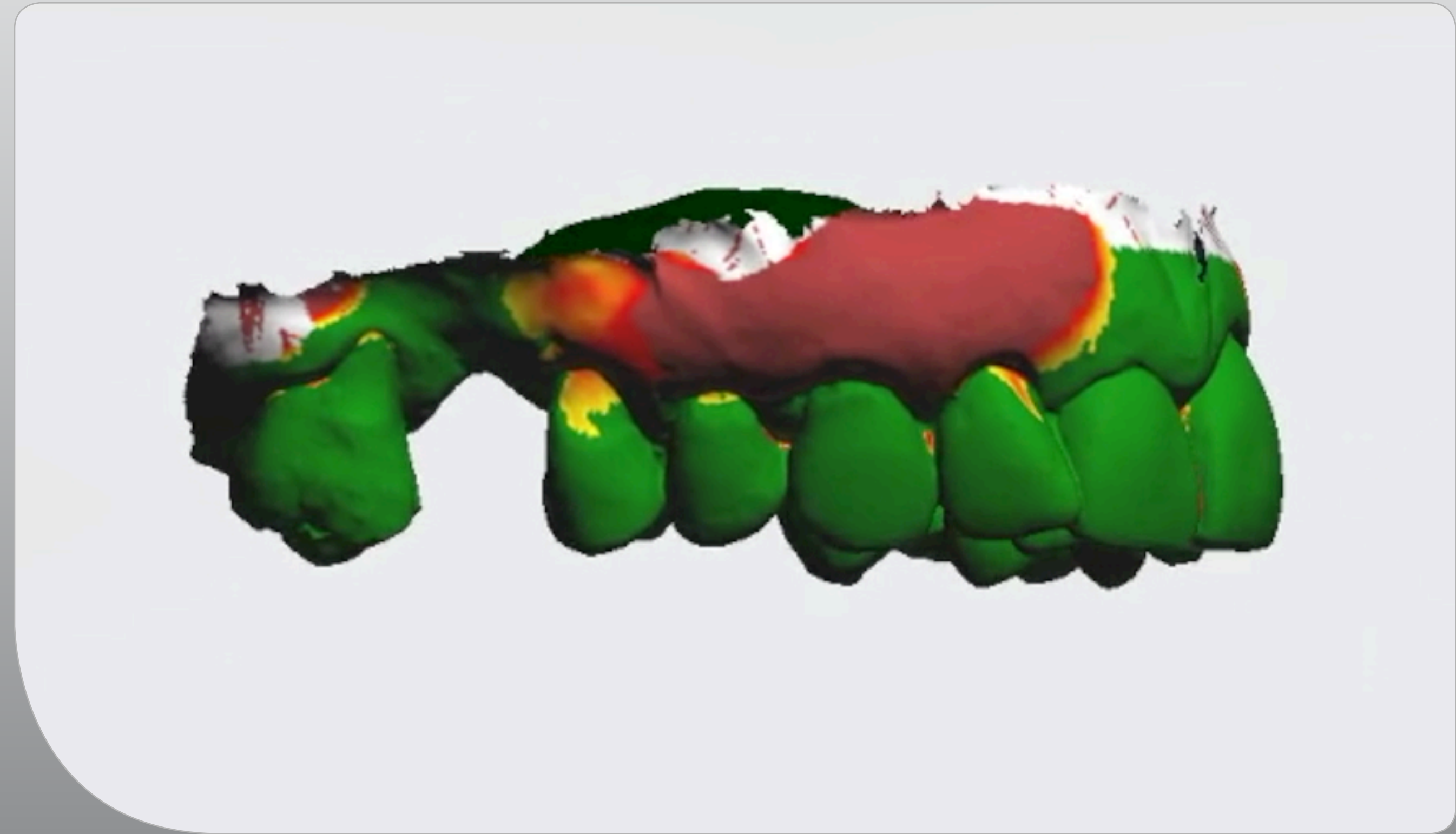
heat map - green indicates high scan correlation

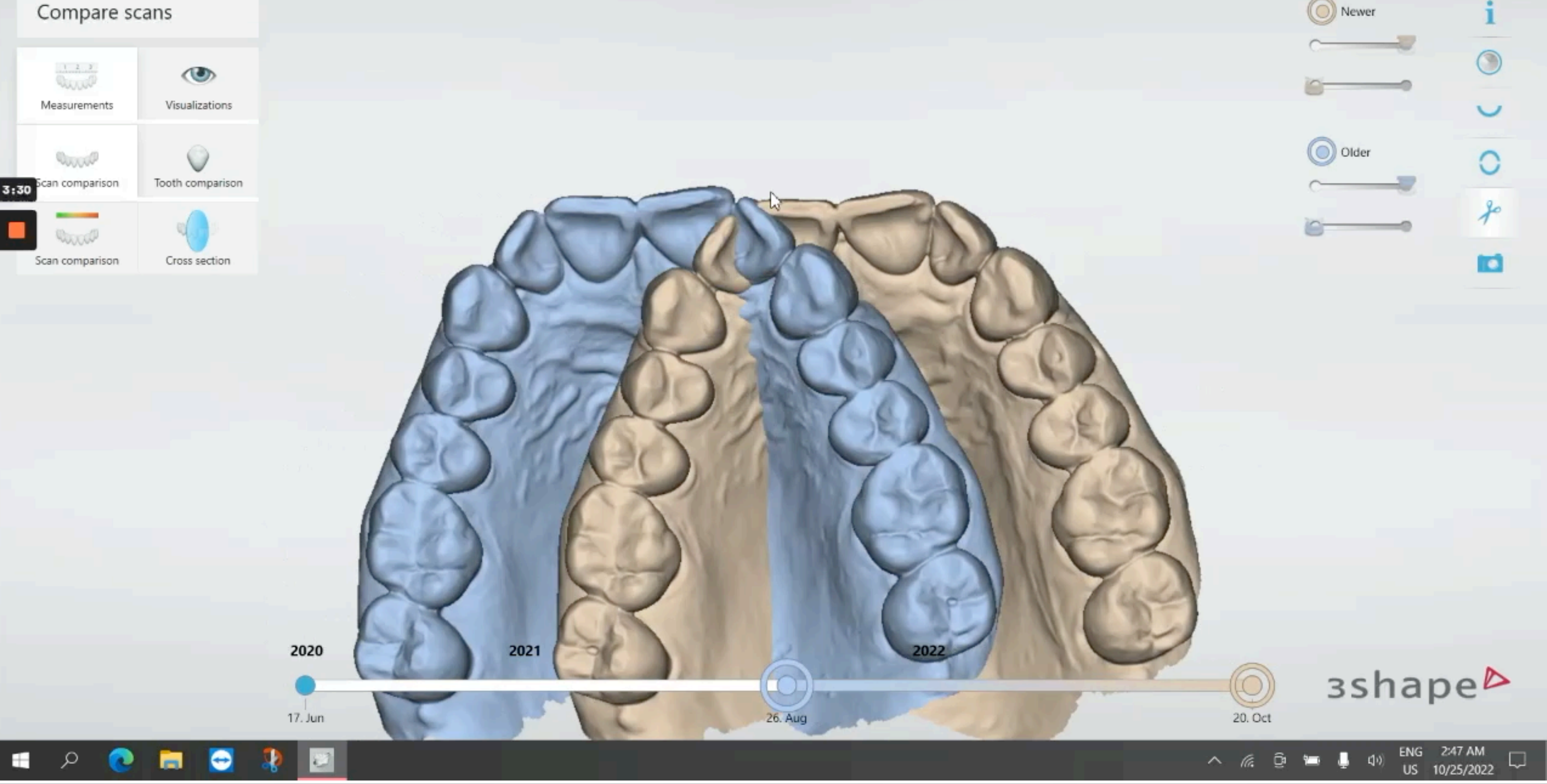


significant soft tissue volume changes (red)

pt's R- 3 weeks after dermal-ARC graft vs 1 year

pt's L - prior to dermal-ARC graft vs 1 year



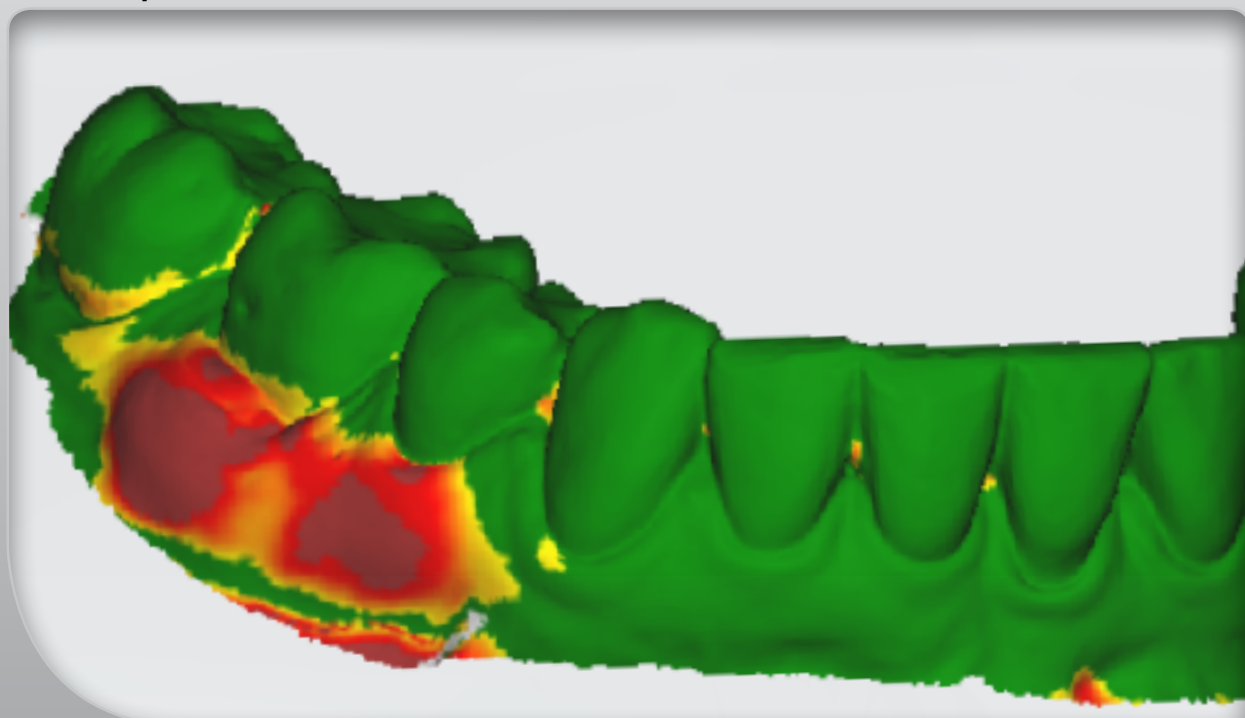


double-layered dermal matrix graft

heat map [change & stability over time]

- green - high correlation
- red - soft tissue volume changes
- 100% root coverage
- volume gain ~ 1.5 - 3mm

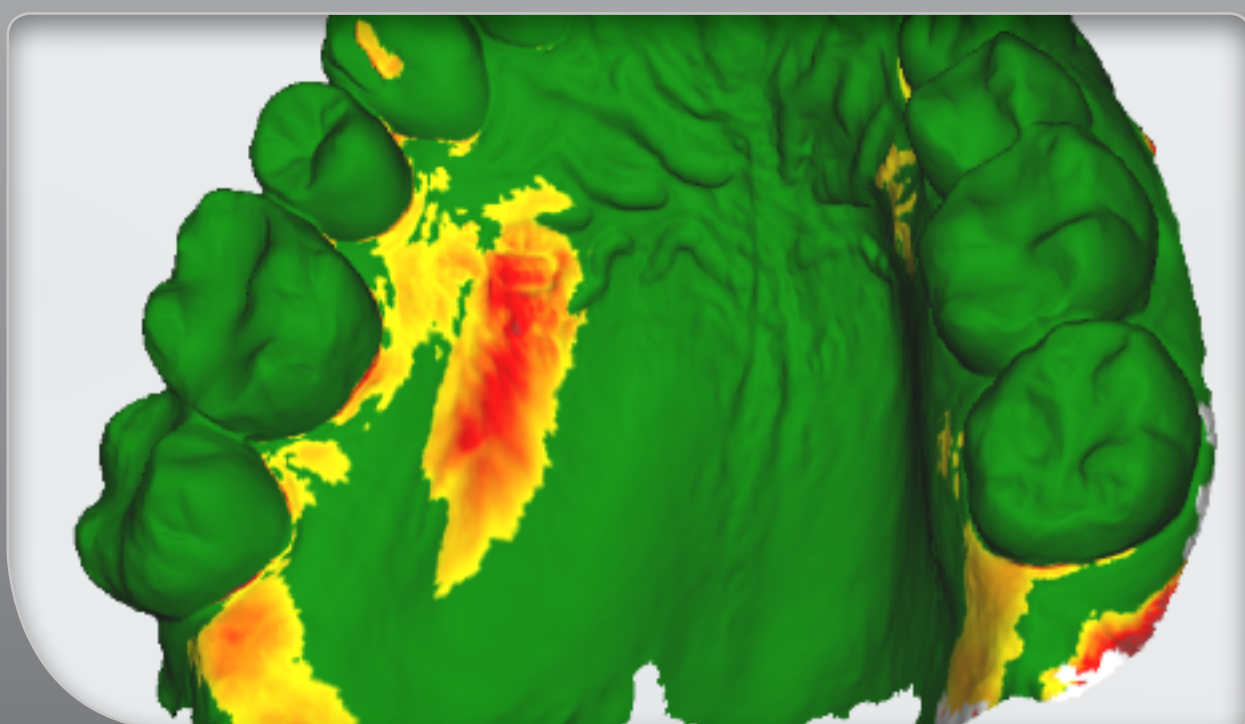
recipient site



1.04-1.3mm volume ↑



donor site



≤ 0.58mm volume ↓



digital follow-up at 12 months post-surgery- CTG

donor site

single incision technique
1° flap closure

I-PRF sheet

up to 0.58mm *volume loss*

VAS: 7/10 X 7 days

recipient site

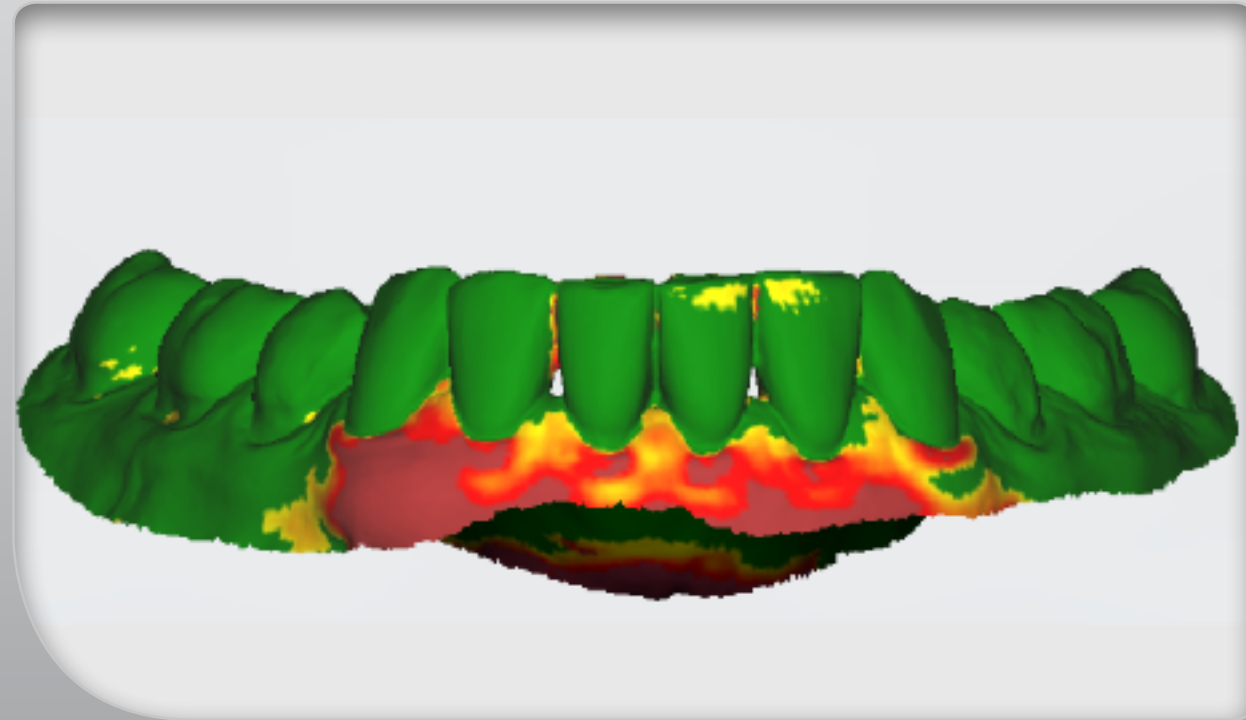
apical tunnel approach/access
point 44 mesial

90% root coverage

up to 1.04mm *volume gain* @
2mm-6mm below margin

VAS: 0/10

33-43 CTG- 1-3mm recession

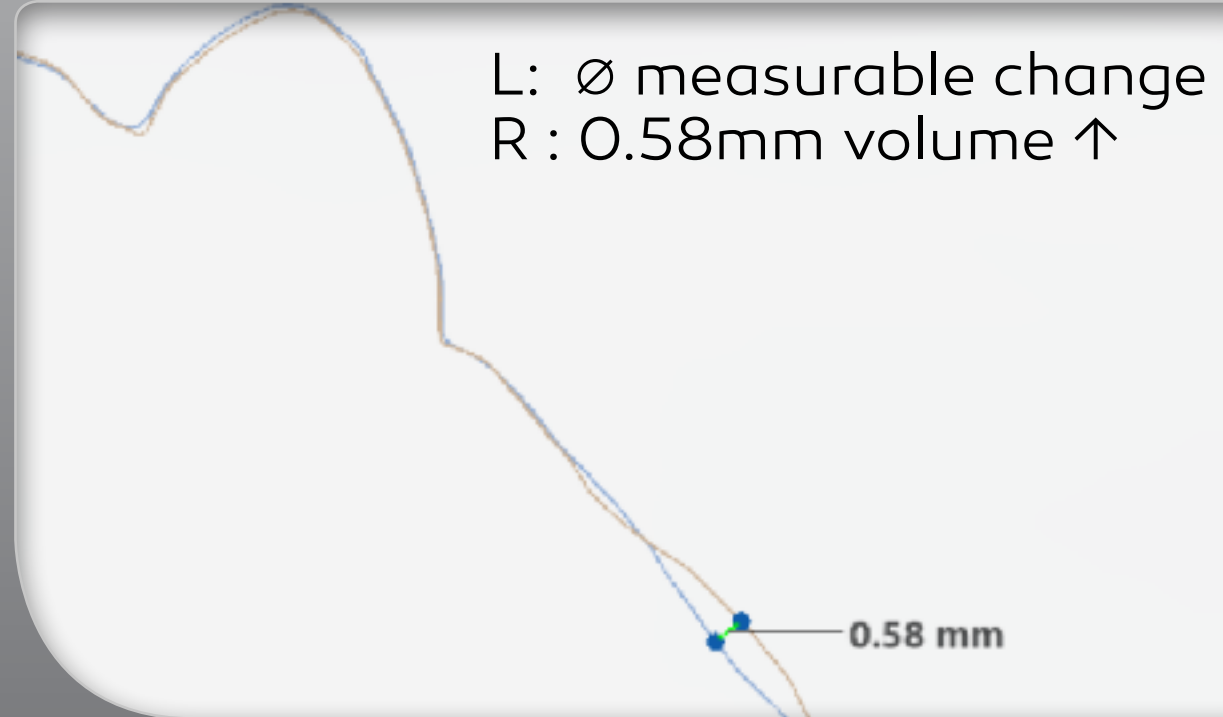
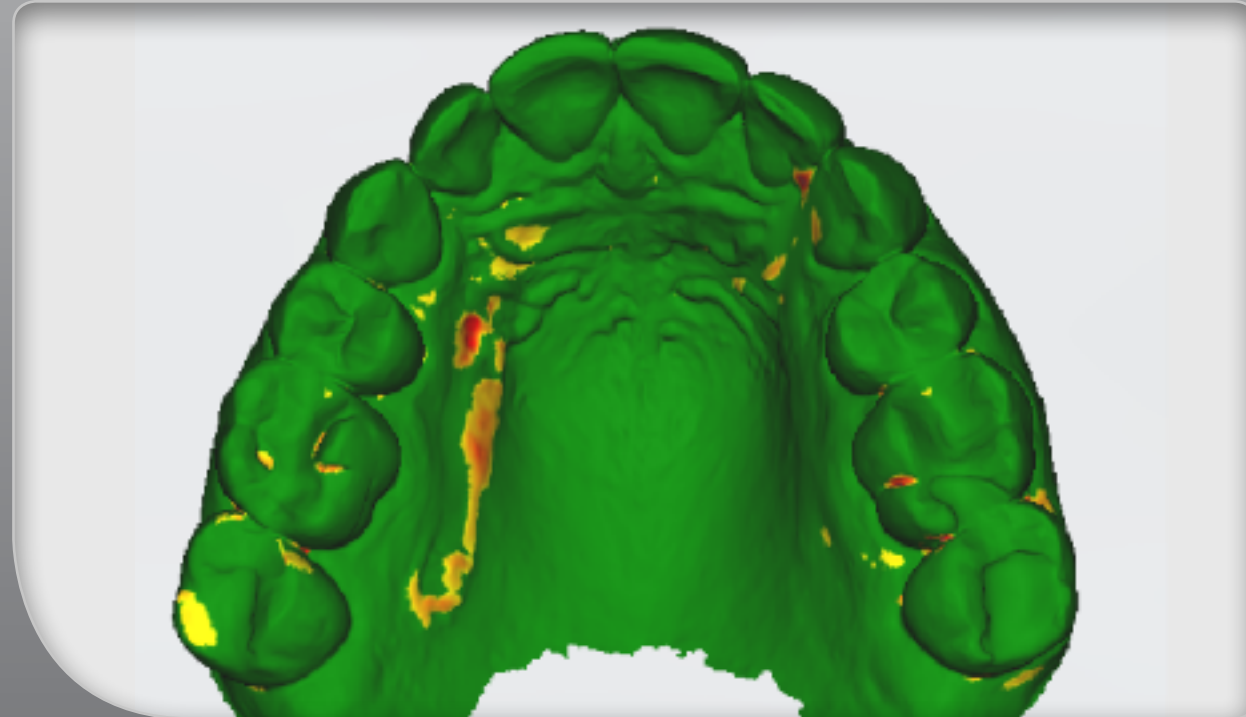


≤ 0.98mm volume ↑ @ 2-6mm



digital follow-up at 12 months post-surgery- CTG

donor sites



donor site

superficial graft harvest
open wound

i-PRF/collagen tape
epithelial discard
sutures R, adhesive L

left - *no volume change*
right- *up to 0.58mm increase*

VAS pain: 8/10 X 5 days

recipient site

full thickness apical approach
vertical incisions 31, 43

100% root coverage

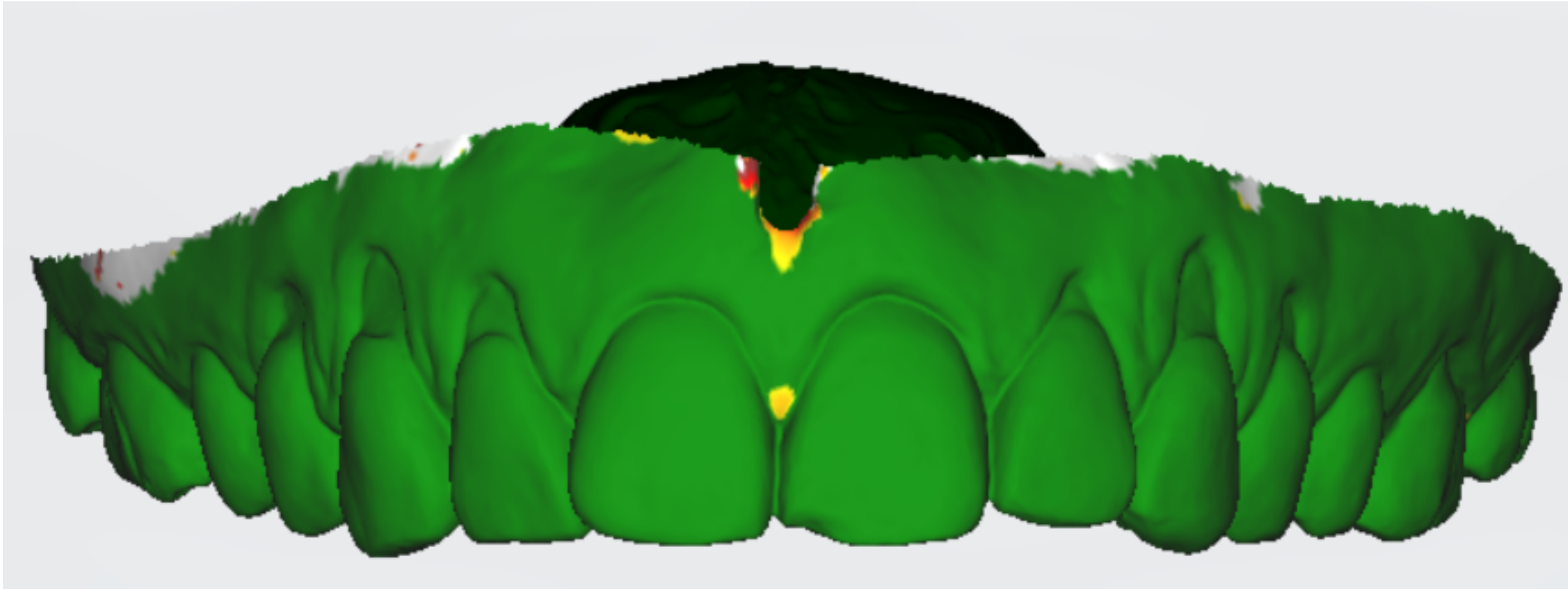
up to 0.98mm *volume gain* @
2mm below margin

VAS pain: 5/10 X 5 days

virtual monitoring & iOS	
	background
	classification systems - why?
	monitor vs treatment
	graft types
	surgical technique
	digital monitoring
	conclusions
cases we treat	<ul style="list-style-type: none"> scan all recession cases [ideally all perio cases] eliminate subjectivity of recession reference points palatal guard fabrication if desired critical appraisal of grafting outcomes . volume gain/root coverage outcome <i>additional cost implication - same as study models ~ \$128 CAD</i>
cases we monitor	<ul style="list-style-type: none"> monitoring - baseline recession record accurate timeline record guide treatment decisions patients 'trust' the data & our decision to treat vs. monitor <i>cost implication - annual recession exam and scan \$340 CAD</i>



making better treatment decisions using optical scans [patient monitoring]



treatment initiated if:

- symptoms increase
- inflammation increase
- restorative/orthodontic plan demand treatment
- esthetic demands
- iOS recession change is documented

50/389 referred cases monitored for 1 + years

[09/2020 to 08/2022]

only 2/50 had recession ↑

> digital technology
where are we heading?



CONCLUSIONS

- 1 treatment planning . minimize complications
- 2 digital workflow essential today
- 3 broad placement/restoration concepts
- 4 hard/soft tissue assessment & management
- 5 technology ... powerful with experience



thank you



@sonialeziy

sonia leziy periodontist
mathieu nault periodontist
iain hart periodontist
brahm miller prosthodontist

vancouver island dental specialists